Engineering Library

AUTOMOTIVE and Aviation INDUSTRIES

NOVEMBER 15, 1946

UNIVERSITY OF MINNESOTA
RECEIVED
NOV
27
1946
LIBRARY

Look for the trademark "TIMKEN"

on every bearing you use

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

It's the Heald No. 75-A Internal, with new anti-friction table ways . . . ready to cut your small-lot grinding costs

EFFICIENCY in small-lot grinding jobs largely depends on ease of operation. And that's one of the outstanding features of the Heald No. 75-A Internal, equipped with new anti-friction table ways for faster, effortless grinding.

Table action on this simple, manually operated Heald Internal is remarkably smooth and easy . . . a mere touch on the handwheel operates the table, hence greatly reduces operator fatigue. Ways are prelubricated for life . . . give instantaneous table response . . . put finger-control precision into small-lot operations.

That's why the Heald No. 75-A Internal is ideal for your tool room—with ample capacity for the general run of face, chamfer and internal grinding. Use it for work up to 2" in length, with either straight or tapered holes, such as gears, pinions, bushings, and rings. You'll find that it Increases the range of your work . . . and brings your costs down.

If you'd like to know more about Precision Finishing Tool Room Work and Small-Lots, we'll be glad to send you our latest 40-page bulletin on the subject. THE HEALD MACHINE COMPANY, Worcester 6, Mass.

HEALD

means more precision
. . . less cost

INTERNAL AND SURFACE GRINDING MACHINES • BORE-MATIC PRECISION FINISHING MACHINES

AUTOMOTIVE and Aviation INDUSTRIES

Published Semi-Monthly — November 15, 1946 — Vol. 95, No. 10

JULIAN CHASE, Vice-Pres. and Directing Editor
J. R. CUSTER, Associate Editor — JOS. GESCHELIN, Detroit Editor
JEROME H. FARRIS, Ass't Editor — H. H. ROBERTS, Ass't Editor
MARCUS AINSWORTH, Statistician — LEONARD WESTRATE, News Editor, Detroit
JOHN C. HILDRETH, JR., Research — HOWARD KOHLBRENNER, Art Editor
L. W. MOFFETT, Washington Editor — R. RAYMOND KAY, Pacific Coast Editor
B. J. HARDY, Washington News Ed. — KARL RANNELLS, Washington News Ed.

CONTENTS

Labor Monopoly—A Road to State-ism. *By Bradford B. Smith* 15
Wage Incentive Plan. *By Leonard Westrate* 17
Progress in Engine Design. *By Joseph Geschelin* 18
A New Idea 20 Years Old 21
The Personal Airplane. *Part One. By Peter Altman* 22
Rototiller Engine 32
Airbriefs. *By Robert McLarren* 33
Looking Forward to Future Automobile Engines. *Part Two. By Alex Taub* 34
Flowmeter for Testing Crankcase Ventilation. *By B. Gratz Brown* 38
Design Trend of Aircraft Exhaust Systems. *By Ralph L. Haver and Harry A. Goodin, Jr.* 40
Observations. *By Joseph Geschelin* 43
1000 Hp, 45 Mph Truck Dynamometer 44
Evans Postwar Auto Railers 44
1946 Registrations. *By Marcus Ainsworth* 45
New Production and Plant Equipment 46
New Products for Aircraft 48
New Products 50
News of the Industry 52
Calendar of Coming Events 58
Advertisers' Index 178

Copyright 1946 by Chilton Company (Inc.)

G. C. BUZBY, President and Manager Automotive Division
E. H. MILLER, Adv. Mgr. — E. W. HEVNER, Cir. Mgr.

REGIONAL BUSINESS MANAGERS

JOHN T. HOOLE, Chicago — HARLAND E. BOYD, Cleveland
E. E. ELDER, Detroit — A. R. ECKEL, New York
NELSON W. SIEBER, Philadelphia — C. H. WOOLLEY, San Francisco
AUGUST HAURIN, JR., Los Angeles

OFFICES

Philadelphia 39, Pa., Chestnut & 56th Sts., Phone SHerwood 7-1424
New York 17, N. Y., 100 East 42nd St., Phone Murray Hill 5-8600; Chicago 1, Ill., Room 916, London Guarantee & Accident Building, Phone Franklin 4243; Detroit 2, Mich., 1015 Stephenson Bldg., Phone Madison 2090; Cleveland 14, Ohio, 1030 Guardian Bldg., Phone Cherry 4188; Washington 4, D. C., 1061 National Press Bldg., Phone District 8109 and 8110; San Francisco 5, Calif., 605 Market St., Room 608, Phone Sutter 4951; Los Angeles 1, Calif., 6000 Miramonte Blvd., Phone Lafayette 5525.

Cable Address ..... Autoland, Philadelphia

Member: Audit Bureau of Circulations; Associated Business Papers, Inc.

AUTOMOTIVE *and* AVIATION INDUSTRIES is a consolidation of the Automobile (monthly) and the Motor Review (weekly), May, 1902; Dealer and Repairman (monthly), October, 1903; the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

Owned and Published by
CHILTON COMPANY (INC.)
Executive Offices
Chestnut and 56th Streets, Philadelphia 39, Pa., U. S. A.

Officers and Directors
Jos. S. HILDRETH, *President*

Vice-Presidents
EVERIT B. TERHUNE — P. M. FAHRENDORF — JULIAN CHASE
WILLIAM A. BARBER, *Treasurer* — JOHN BLAIR MOFFETT, *Secretary*
THOMAS L. KANE — G. C. BUZBY — HARRY V. DUFFY
CHARLES J. HEALE

WILLIAM H. VALLAR, *Asst. Treas.*

PAUL WOOTON, *Washington Member of the Editorial Board*

A Radiator Built for

STOP and GO

Driving . . .

ANOTHER EXAMPLE OF YOUNG ENGINEERING SERVICE

Young sheet metal construction radiator (right) for light delivery truck installation, is used for cooling Marmon-Herrington DELIVR-ALL. Note heavy bottom band support, forming cradle mounting for radiator. Pressure filler cap is used to allow higher water temperatures and prevent water loss by vaporization.

● Making hundreds of starts and stops every day, in all kinds of weather, is no problem for the Marmon-Herrington DELIVR-ALL truck, because it's cooled by a Young Radiator. Continual stop-and-go operation gives the engine terrific punishment . . . requires a radiator that can take it, too! Young Engineers are continually called upon to meet challenges like this . . . to design or adapt radiators to specific requirements. For more than 15 years Young has helped solve many different types of cooling problems for Marmon-Herrington Company, Inc. Whatever your cooling needs may be, the experience of Young Application Engineers is available without obligation.

YOUNG Young Quality

HEAT TRANSFER PRODUCTS

OIL COOLERS • GAS, GASOLINE, DIESEL ENGINE COOLING RADIATORS • HEAT EXCHANGERS • INTERCOOLERS • ENGINE JACKET WATER COOLERS • EVAPORATIVE COOLERS • GAS COOLERS • UNIT HEATERS • CONVECTORS • CONDENSERS • AIR CONDITIONING UNITS • EVAPORATORS • HEATING COILS • COOLING COILS • *And a Complete Line of Aircraft Heat Transfer Equipment.*

YOUNG RADIATOR COMPANY
DEPT. 216-L-2 — RACINE, WIS., U. S. A.

AUTOMOTIVE *and* AVIATION INDUSTRIES. Vol. 95, No. 10. Published semi-monthly by Chilton Co., Chestnut & 56th Sts., Phila. 39. Entered as Second Class Matter October 1, 1925, at the Post Office at Philadelphia, Pa.; Under the Act of Congress of March 3, 1879. In case of Non-Delivery Return Postage Guaranteed. Subscription price: United States, Mexico, United States Possessions, and all Latin-American countries, $1.00 per year. Canadian and Foreign $5.00 per year; single copies, 25 cents, except Statistical Issue (Mar. 15th), 50 cents.

SHEET METAL SCRAP IS *Valuable* RAW MATERIAL

Model MC Floor Type, Double Compression, Hydraulic Baler for Stampings, Clippings and Non-Ferrous Sheet Scrap.

Get Top Prices for YOURS
. . . *Bale it the* G-H *Way!*

HYDRAULIC BALERS

— range in size and capacity from ¼ ton per hour to 20 tons per hour, and more . . . from Portable Floor-Type Models, as pictured above, to giant Triple Compression Pit-Type Balers for heavy industry and scrap yards.

There is always a ready market for sheet metal scrap, both ferrous and non-ferrous. To mills, smelters and foundries, it is an important raw material, highly essential in the production of new metals.

Sheet metal scrap is most valuable when it reaches these users in dense, compact bales, correctly sized and classified. Then it can be used immediately, without extra handling or preparation, to charge furnaces or cupolas. That's why baled sheet metal scrap commands top prices.

Galland-Henning Hydraulic Balers are designed and constructed to convert sheet metal scrap into dense, usable bales at the lowest possible cost-per-ton. They are engineered and constructed for years of efficient, high speed performance with a minimum of maintenance. For helpful counsel on your sheet metal salvage problems, write —

GALLAND-HENNING MFG. CO.
2747 S. 31st STREET • MILWAUKEE 7, WISCONSIN

GALLAND-HENNING
SCRAP METAL BALING PRESSES

When writing to advertisers please mention AUTOMOTIVE *and* AVIATION INDUSTRIES

AUTOMOTIVE and AVIATION INDUSTRIES

Published on the first and 15th of the month

Volume 95, No. 10
November 15, 1946

Labor Monopoly— A Road to State-ism

By Bradford B. Smith
Economist, U. S. Steel Corp.

THERE are many roads by which we have been traveling toward controlled economy and the omnipotent state. In some respects the broadest are the least perceived. Among them is the monopoly road to state-ism. There is one type of monopoly that is currently a serious threat—it is labor monopoly. Its nature is daily becoming clearer to more and more people.

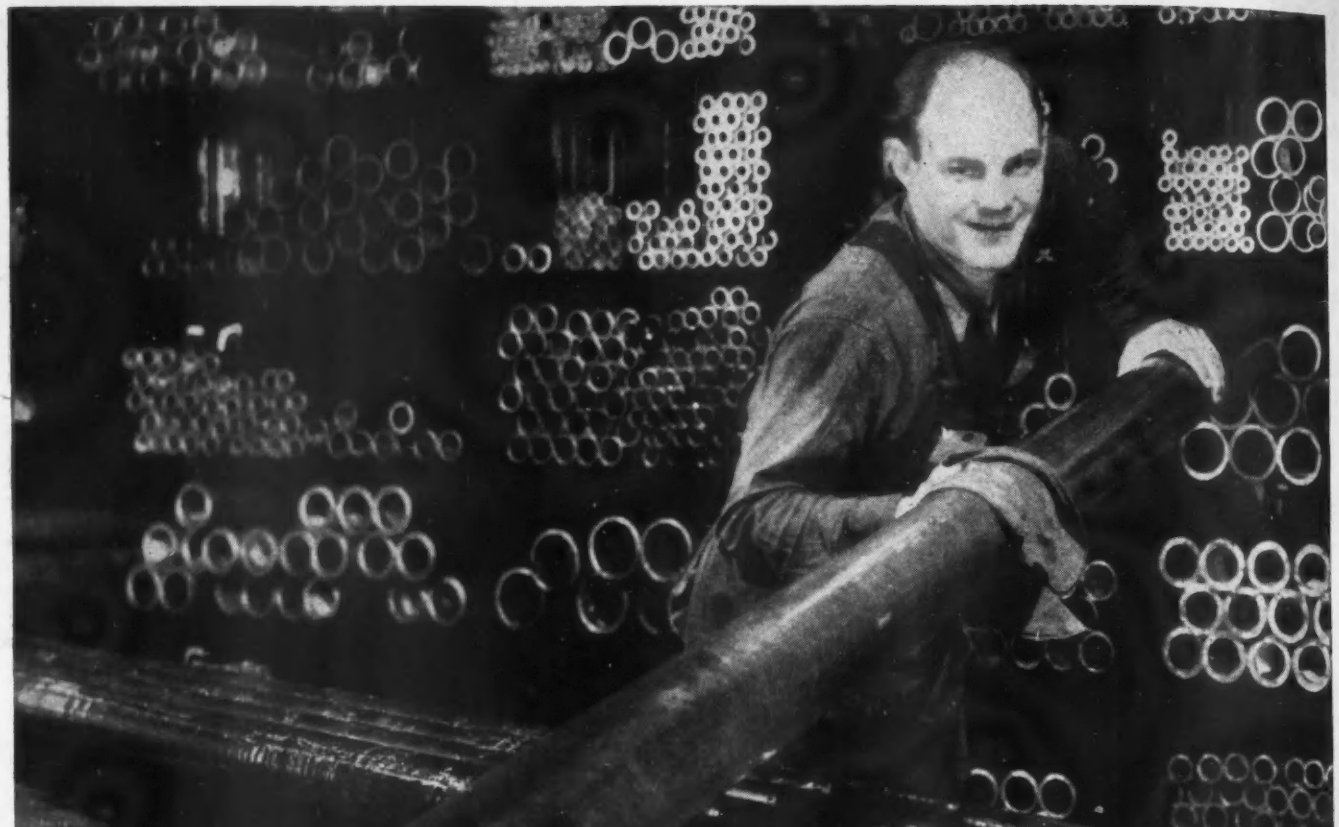
The laborer is not a commodity, but the service he renders cannot escape economic law. That means quite simply that if the service is made artificially costly, then just like anything else, customers will buy less of it than otherwise. Labor, like anything else, can price itself out of its market, if given monopoly status. It has achieved monopoly status. In actual practice this means that in determining the price paid for labor—the wage rate—many employers are permitted to deal with but one entity, subjected to neither individual nor group competition. This is monopoly obscured but monopoly price control nonetheless. It is tantamount to saying to each one of you that the price you must pay for bread from whomever purchased is nevertheless to be set by one baker, no other being permitted to offer a lesser price in the hope of getting your business. It is the exercise of great power, and, like all power it tends to feed upon itself and to be abused to the injury of the innocent.

Tolerance of the growth of this power springs from two great misconceptions. The first one is a false identification of the individual's right to escape enforced servitude by quitting a job in search of a better one with the legal privilege of a number of workers collusively to stop working without quitting the job in order to exert monopolistic pressure. The one is the practice of individual freedom in a system of voluntary markets; the other is the denial of individual freedom by the substitution of monopolistic for competitive markets. The right to quit and the privilege of striking are not equivalents but opposites in the functioning of voluntary markets.

The second great misconception is that workers are in competition with employers, instead of with each other; in short, that in employer-employe relations competition suddenly runs vertically instead of horizontally, and that "bargaining power" must somehow therefore be equalized. The fact is, of course, that when I buy a certain make of car it is not my relative bargaining power which protects me. If it were, I would be quite unprotected! It is the presence of other manufacturers which keeps me from being exploited. Similarly it is the presence of a lot of other little fellows with whom I must compete to get a car which keeps me from exploiting the motor companies regardless of *their* bargaining power. It always is the competition of sellers that protects buyers; the competition of buyers that protects sellers; sellers are never in competition with buyers.

(*Turn to page* 86, *please*)

PROTECT YOUR FUTURE
BUY YOUR EXTRA SAVINGS BONDS NOW
SECURITY



Here's Your Tubing

Quick Shipment from Large Ryerson Stocks

IN STOCK

Low Carbon, Cold Drawn Seamless Mechanical Tubing
Regular and Pump Cylinder Finish

High Carbon, Cold Drawn Seamless Mechanical Tubing

Structural Tubing—Hot Rolled, Butt Welded

Boiler Tubes—Seamless and Electric Resistance Welded

Allegheny Stainless Seamless Tubing—Type 304

Allegheny Stainless Seamless Pipe
Type 304—Standard and Extra Heavy Weight
Types 316 and 347 Standard Weight

Allegheny Stainless Welded Pipe
Type 304—Standard Weight

Hot Finished and Cold Drawn Alloy Steel Tubing and Aircraft Quality Tubing Available from Mill Only.

It's just what you ordered because we continually check the size-accuracy, concentricity and straightness of our tubular stocks.

Its surface is smooth and scale-free because close control over every manufacturing step, from selection of the highest grade billets, through piercing and drawing, to the finished tube, assures a top quality product.

You'll find that constant experimentation to improve machining qualities has paid off in good machinability within the limits of the analysis specified. In short, nothing is overlooked that will help you put this tubing to work as a finished part, quicker and with less waste.

Convenience is another advantage of Ryerson service on tubular products. Large, diversified stocks are on hand for prompt shipment in eleven completely equipped plants . . . providing next-door service most everywhere.

A Ryerson tubing specialist will work with you on all tubular requirements. Get in touch with the plant nearest you when you need tubing from stock.

JOSEPH T. RYERSON & SON, INC., Steel-Service Plants: Chicago, Milwaukee, Detroit, St. Louis, Cincinnati, Cleveland, Pittsburgh, Philadelphia, Buffalo, New York, Boston.

RYERSON STEEL

A Union-Accepted

Wage Incentive Plan

Based on Group Effort

By Leonard Westrate

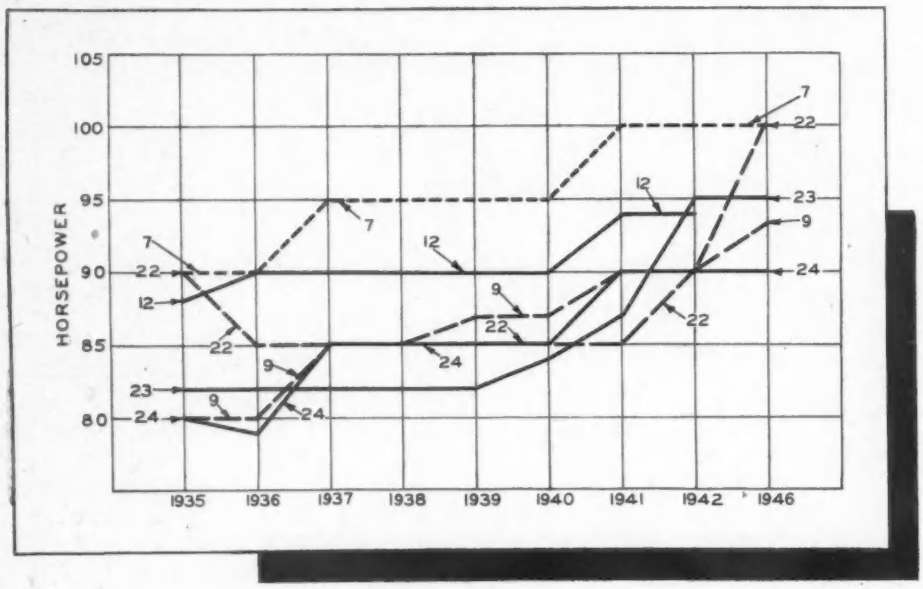
In the automotive industry today there is a pretty definite belief that the only answer to higher wages is a commensurate increase in production and that some type of pay incentive plan would be desirable. The UAW-CIO, on the other hand, is just as definitely opposed to wage incentives, and has succeeded in knocking them out of most automotive plants. In fact, there have been some protracted strikes in the industry this year over that issue. In view of these opposing views, it is interesting to note what has happened at the plant of one automotive supplier that has gone to a modified incentive system based on group effort of all employes rather than on piecework rates determined by theoretical or time study standards.

The background leading up to adoption of the plan is interesting. The Bundy Tubing Co., Detroit, manufactures small patented tubing. Production of the tubing is largely a machine process, but fabrication to customer order is largely hand work and the fabrication department employs 75 per cent of the total workers. When the company late last year took stock of reasons for declining output and profits, production records showed worker efficiency to be 45 per cent of the 1937 standard, before piecework rates were supplanted by hourly rates. Bundy had lost a sizeable segment of its fabricating business and its competitive position in relation to filling orders and keeping costs down was jeopardized. The upshot was that the company decided to go out of the fabricating business at its Nine Mile Road plant, with the resultant loss of jobs for 75 per cent of its hourly wage workers and 80 per cent of its supervisory personnel. Bundy President, Wendell L. Anderson, informed em-

(*Turn to page 82, please*)

By Joseph Geschelin

Progress

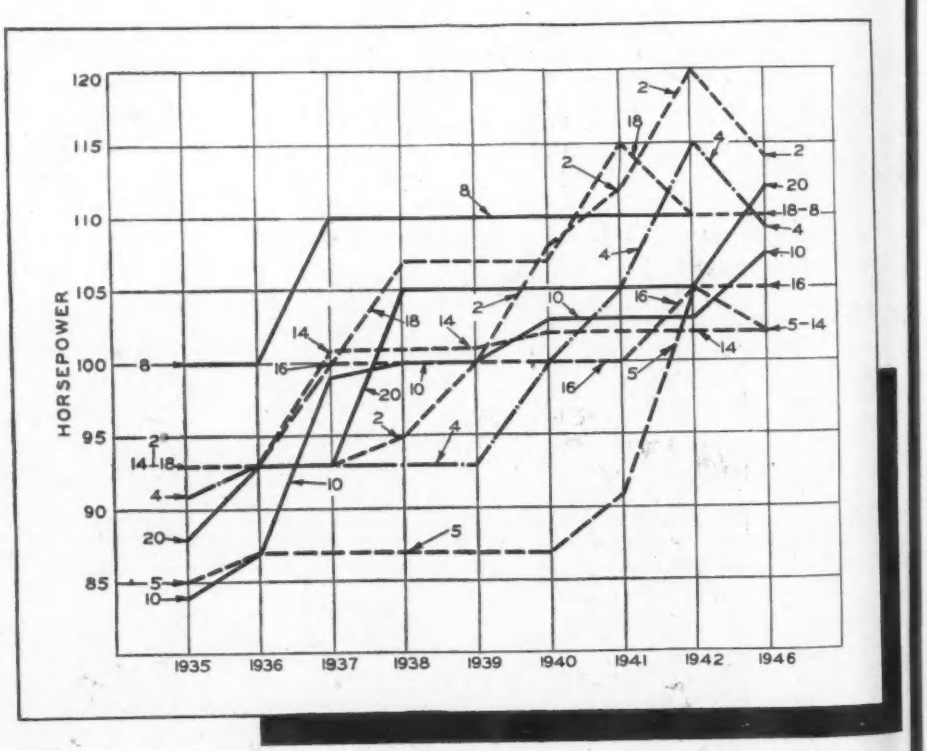


1—Historical record of change in engine horsepower for certain engine models.

STRAWS in the wind indicate that major changes in motor car engines may be expected within the next two years to take advantage of fuels of higher octane value. But that is not the only reason for making the change. Analysis of engine specifications shows pretty clearly that many of the engines currently in production have just about reached the area of diminishing returns so far as further improvement in performance or output or fuel economy is concerned. The time is ripe for new engines tailored to the requirements of advanced post-war motor cars.

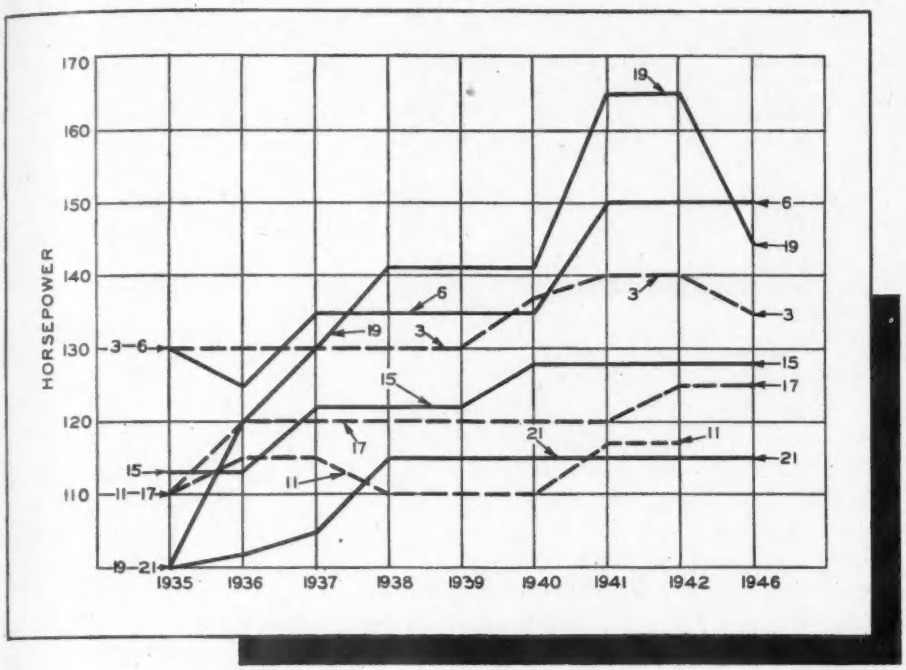
Engine designers deserve a great deal of credit for their ability to stay within the limits of a basic engine design and yet progressively increase specific output, improve performance and fuel economy. One has only to look at the specifications year by year to confirm this observation. On the other hand, at the risk of making a sweeping generalization, the record reveals that most prominent makes stem from approximately the same basic models of ten years ago or more.

The process has been one of evolution. The skill and ingenuity of the designer have been bent to the task of taking advantage of new developments instrumental in producing refinements and sometimes radical changes in materials, design detail, and accessories. As a result the engines of today excel in longer life and greater freedom from service difficulties



2—Historical record of change in engine horsepower for certain engine models.

in Engine Design



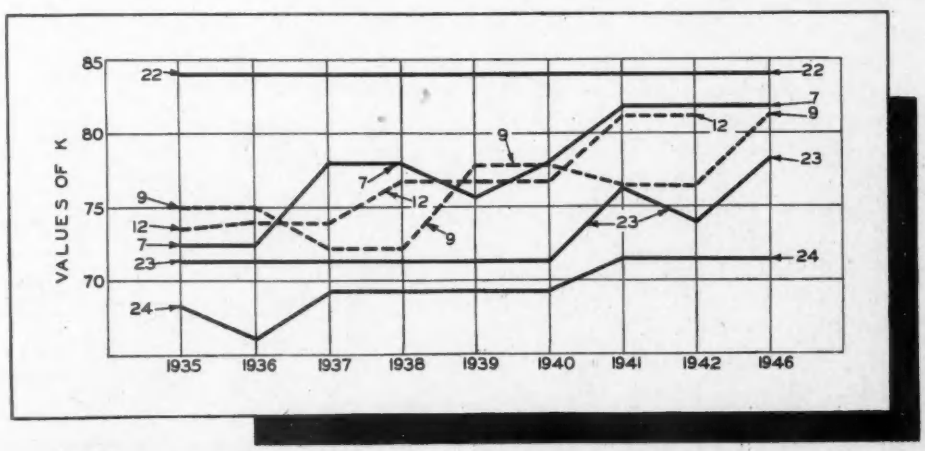
3—Historical record of change in engine horsepower for certain engine models.

and are on a higher plane of achievement than anything the industry has offered in the past.

To get a better picture of the historic record, we have made a study of engine specifications as appear in the Annual Statistical Issue of AUTOMOTIVE & AVIATION INDUSTRIES from 1935 to 1946 inclusive. Out of the many engine models thus listed we have selected a group which has persisted during these years. For convenience and ease of charting, the data on maximum horsepower have been sifted into three arbitrary bands. Fig. 1 covers a group of engines rated from 80 to 100 hp; Fig. 2, from 85 to 120 hp; Fig. 3, from 100 to 165 hp.

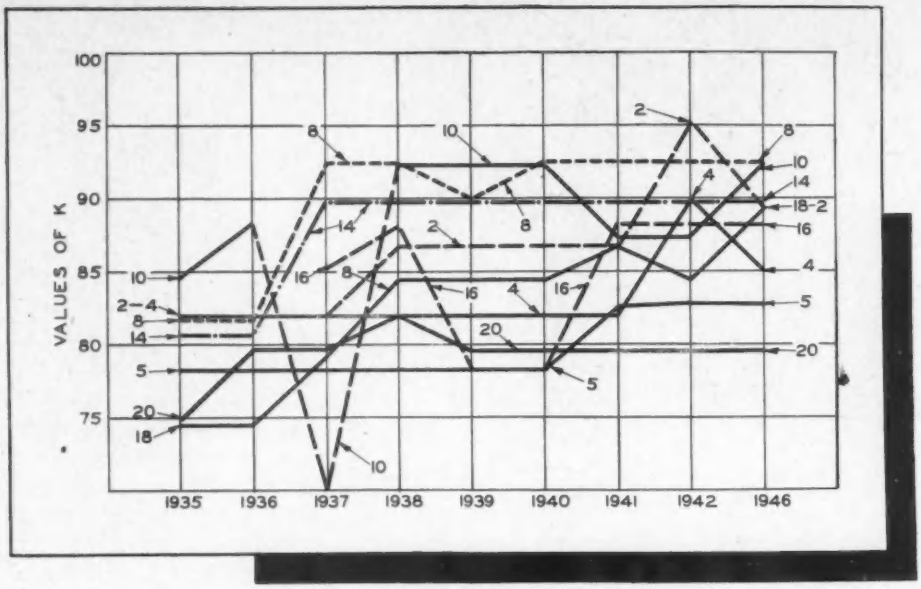
Examination of these charts shows the regular trend to higher output although the rate of increase naturally varies in each case. In a few instances on the engines in Fig. 2 and 3, the rated output for 1946 dropped from the high point in 1941 and 1942. During the period 1935-1946 changes have been made in many ways, including increases in displacement but the fact remains that we have been observing a change in what may be termed a "basic" engine.

What are the elements—from a historic standpoint—that have been responsible for this progress? First there is a moderate increase in displacement by increasing the bore or increasing the stroke or by both means at the same time. Cylinder wall thickness, space for water jacketing, and cylinder spacing serve as the limits to further increases in the bore. By the same token the clearance at the lower end of the cylinder block and within the crankcase limits the changes in stroke. Thus there is a definite ceiling on displacement. Some gain also is obtained from an increase in engine speed. The record shows that engine speed has been going up but this trend is not too consistent. (*Turn page*)



$$4\text{—}\text{“K”} = \frac{\text{displacement (cu. in.} \times \text{speed (rpm)}}{10{,}000}$$

Values of "K" for group of engines charted in Fig. 1.



5—"K" = displacement (cu in.) × speed (rpm) / 10,000

Values of "K" for engines charted in Fig. 2.

that low first cost, long life, ease of servicing and, in particular, smoothness and quietness of operation are restraining influences. Any attempt at further improvement in output must take into account the proper balance of these elements.

Since we are making an historic analysis, it is of interest to see what has happened by way of changes in displacement and engine speed. Since the data are quite voluminous and difficult to organize in simple form, we have resorted to an arbitrary device for the purpose of charting. We have elected to combine the two variables—displacement (in the form of changes in bore and stroke) and engine speed, in a factor "K" which is, in effect, a measure of breathing capacity. For graphic presentation, the value of "K"—the product of displacement (cu in.) and speed (rpm)—is divided by 10,000 to give small numbers.

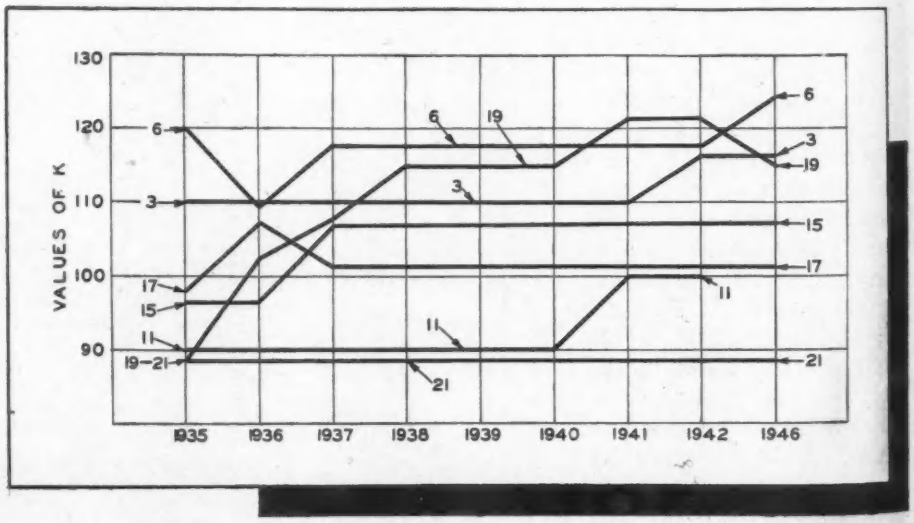
Although "K" is a definite measure of breathing capacity, it does not include the influence of compression ratio nor does it picture the effect of other design changes. Consequently, it is not intended to correlate completely with the corresponding changes in engine output. "K" charts, Fig. 4, 5, and 6 correspond to the engine curves, Fig. 1, 2, and 3 respectively and are intended simply to show the trend in breathing capacity alone. A major change in slope is an indication of a change in any of the three variables—bore,

(*Turn to page* 88, *please*)

Moreover, the stroke and engine speed are interdependent. What limits the stroke also limits the speed, the latter usually being limited by breathing capacity and sometimes by the crankpin bearing load.

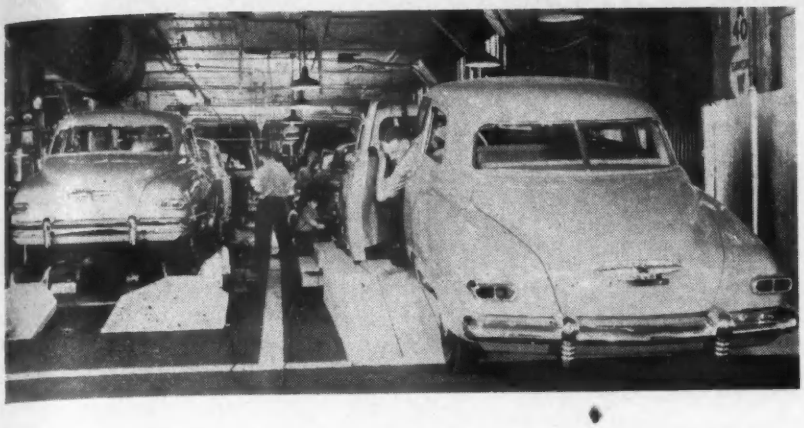
One of the major elements credited with increased output is compression ratio. It is a matter of record that this has been steadily increasing from a range of 5.25 to 6.7 in 1935, to a spread of from 6.3 to 7.25 in 1946. It is also of interest to note a grouping of most makes around a mean value of 6.1 to 1 in 1938. With increases in compression ratio there have come improvements in cooling—better distribution of water jacketing, elimination of hot spots, etc., — in better breathing by changes in carburetion, better mixture distribution, improvements in manifolding, by changes in valve gearing, and other means. Although compression ratio has been increasing steadily there is a ceiling on this for any current engine. And it is inescapable that the law of diminishing returns eventually begins to play a major role.

Considering the many variables susceptible of adjustment at the will of the skilled designer, it would be rash for anyone else to judge when a given engine may have reached its peak of development. Doubtless it would be feasible to continue the process of increasing specific output for a considerable length of time if that were the only object of the designer. But it is the fact



6—"K" = displacement (cu. in.) × speed (rpm) / 10,000

Values of "K" for engines charted in Fig. 3.



1947 Studebakers coming off final assembly lines in reverse.

A New Idea 20 Years Old

A SHORT while ago there appeared in a publication a photograph of the final assembly line of 1947 Studebaker passenger cars, running backwards, which was described as an innovation. Immediately the company began to receive queries regarding this seeming abnormality. Was it true? What were the advantages? Who thought it up?

The company was mildly surprised by the stir of interest. The assembly line had been running backwards since its installation. Either the company had concealed the setup well over a period of approximately 20 years or the method had been publicized and forgotten. It was, in any event, no novelty to employes.

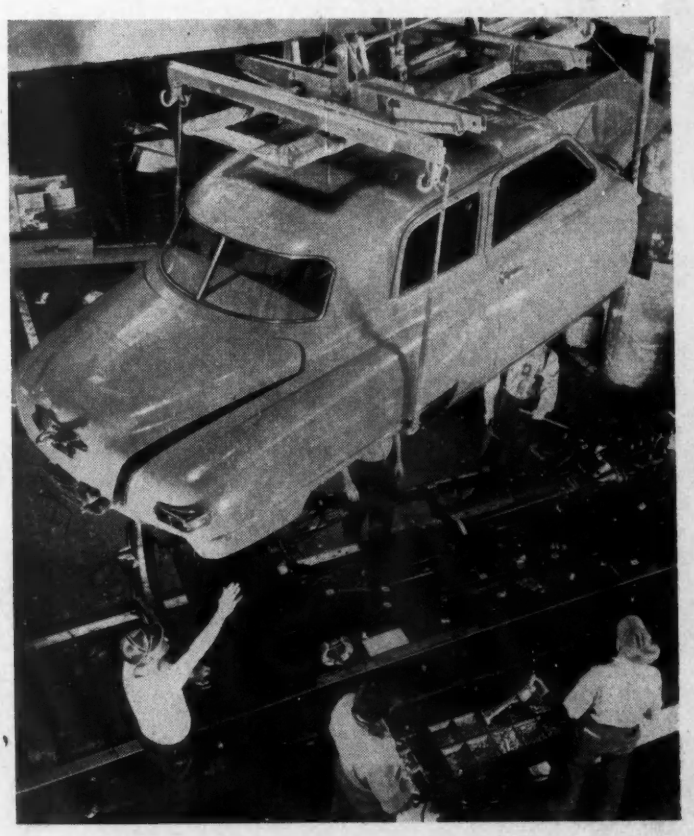
An observer found one probable advantage, one possible advantage and one very sound reason. The "probable advantage" is that the steering column threads more readily into the opening under the dash while the chassis is being pulled toward the body. The "possible advantage" is that most of the assembly operations are performed at the front of the automobile and workmen follow their jobs rather than back away from them. The "very sound reason" is that Studebaker assemblers are accustomed to this manner of building automobiles and a reversal would offer no apparent benefit.

"I am not prepared to argue that we build more efficiently than on the conventional line of head-first automobiles," states a Studebaker production official. "I do know, however, that we have a fast, smooth-working body drop. According to our schedule, the sling must pick up a body on the third floor, drop it on to the second floor chassis and return to pick up another body, all in less than two minutes. We have no time for wasted motion."

The Studebaker body drop is located midway on the vertical element of an L-shaped production system. Frames start on the shorter, horizontal element and are then transferred to the main chassis line at a point immediately below the beginning of body wiring. Subassemblies feed in from both sides.

Auto assembly processes of the Studebaker plant actually cover two virtually identical parallel lines, one exclusively for Champions and one which at the time of writing contained a mixture of Champions and Commanders. These two lines converge shortly after frame boring, but again become distinct with the first major chassis steps. In capsule form and chronologically listed, the assembly of the 1947 Studebakers

(*Turn to page* 90, *please*)



Backward movement of the chassis is said to facilitate assembly at the body drop. The chassis conveyor is moving from right to left in the photograph, pulling the steering post toward the opening in the floor below the dash.

By Peter Altman
Engineering Consultant

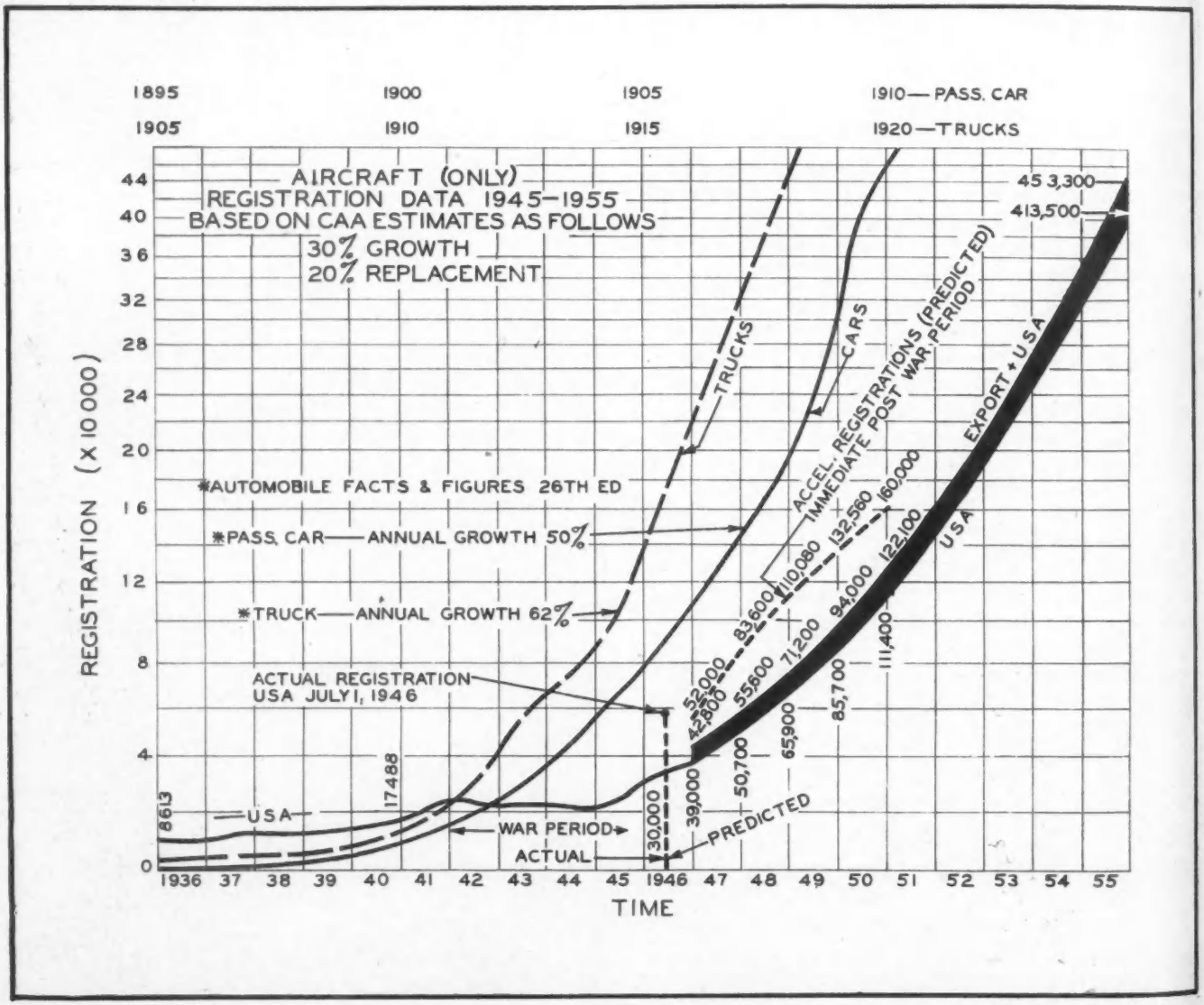
The Personal

Part

A GOOD indication of the market possibilities of the personal type airplane, the design trends and the improvement in utility factors are presented in this article by an engineer who has been engaged in aircraft work for a period of over 26 years, during which a large part of this activity has been with the smaller type of aircraft, particularly of the private owner or personal airplane type. Part I in this issue deals with the market survey, and Part II, which will be published in an early issue of AUTOMOTIVE AND AVIATION INDUSTRIES, will

ALL facts and figures definitely indicate that the personal airplane has reached the state of utility where it is taking its place as a part of the personal means of transportation for business and pleasure of the executive, the salesman, the engineering and plant representative, the farmer and the sportsman. Recent activities in certain fields even indicate the use of these airplanes for the delivery of light and medium weight articles for emergency requirements. Under present supply conditions it is not unusual to see the delivery of small quantities of

Fig. 1—Actual and predicted registration of civil aircraft, as compared with actual registrations of passenger cars and trucks in representative periods of growth and utility. Passenger car and truck time scales are at top of chart.



Airplane *its Market, Design and Utility*

One

discuss the design trends and utility factors.

Selection of significant data and conclusions are based on a careful analysis by the author of (a) statistical data released by the various Government agencies and industry organizations; (b) design data released by manufacturers; (c) interviews with the owners and operators in various sections of the country from the East Coast to the West Coast as a part of an extensive tour of the industry and (d) interviews with representative manufacturers of personal type aircraft.

critical materials, instruments, accessories and other items direct from the source of supply to the manufacturer. There have been a number of instances where deliveries of this kind have enabled manufacturers to continue production, whereas without these facilities it would have been necessary to stop operations completely. It is also quite a common occurrence in visits to airports throughout the country to see executives and manufacturers' representatives arrive in their personal airplanes to transact a day's business and be on their way again before the day is over, to

Fig. 2—Actual and predicted production of civil aircraft, as compared with actual production of passenger cars and trucks for representative periods of growth and utility. Passenger car and truck time scales are at top of chart.

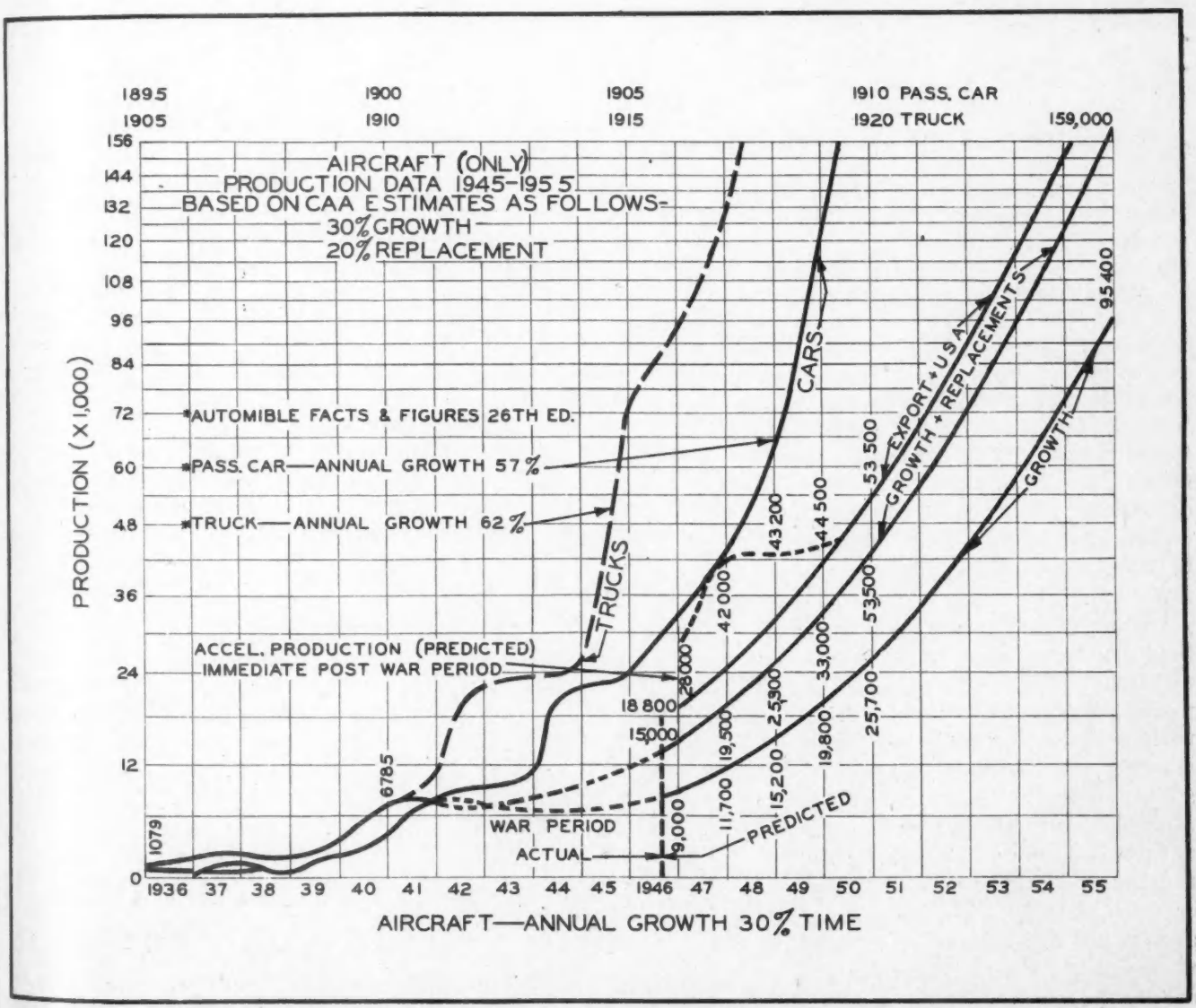


Table I

Registered Civil Aircraft by Total Rated Horsepower

(September 1, 1946)

TYPE BY NUMBER OF ENGINES	Total Rated Hp	Number of Aircraft
SINGLE ENGINE	16 - 65	30,842
	66 - 84	5,233
	85 - 99	4,385
	100 - 144	2,547
	145 - 199	6,990
	200 - 299	6,132
	300 - 499	3,913
	500 - 999	819
	1000 - 3000	37
Total		60,898
TWO ENGINE	130 - 450	1,718
	500 - 999	423
	1000 - 1999	180
	2000 - 2999	1,198
	3000 - 4000	8
Total		3,527
THREE ENGINE	300 - 1575	41
FOUR ENGINE	2800 - 6000	385
	6001 - 8000	54
Total		439
* Grand Total all types		64,905

* Registered aircraft, including gliders, free balloons, etc., as of September 1, 1946 total 67,028.

the next stop in their itinerary. The advantage of this type of travel obviously lies in the fact that the schedule of departure and arrival is flexible and entirely up to the individual and the itinerary can extend to any place where landing facilities are available.

The growth of every commodity follows a very uniform pattern from the early stages of its conception when progress is slow and utility is low to the point where the commodity increases in utility—where it can become a part of the personal and industrial activities of many people. At the latter stage demand for the commodity begins to increase and if the utility continues to improve, the demand increases at a rather rapid rate for a number of years until a condition of equilibrium is attained at a point where the demand and utility balance. At this point production continues at a fairly uniform rate as determined by the replacement requirements of the units already in use. A study of the growth of such representative commodities as automobiles, radios, refrigerators and many others, definitely shows the occurrence of this type of development and growth and a similar analysis of the personal aircraft industry shows exactly the same trends.

Airplane Registration

Figs. 1 and 2 are presented to illustrate this point. Fig. 1 represents a chart of the actual and predicted registration of aircraft for the period of 1936 to 1955. Superimposed on this chart is also the actual registration of passenger cars for the period of 1895 to 1915 and commercial trucks for the period of 1905 to 1925. The period for the passenger car and truck registration was selected as representative of the same state of growth and utility of these two commodities as is believed will occur in the aircraft industry. The gradual and slow rate of development in the early periods can be noted for all three units. In the case of the airplane, actual registration is shown for the period of 1936 to 1945 for civil aircraft only. The predicted normal registration for the period 1945 to 1955 is based on an assumed growth of 30 per cent and an assumed replacement of 20 per cent. Based on these figures, a registration of 42,800 should occur at the end of 1946 and 453,300 at the end of 1955. These figures include the export of civil aircraft from the United States. It is natural to expect that because of the accelerated activities of the aircraft industry during the war period and the release of the "pent-up" demand for airplanes at the end of the war, that registration should increase at a greater rate than that assumed by the normal growth and replacement values. This is demonstrated by the fact that on July 1, 1946, there was already a registration of 57,488 airplanes in the United States alone. At the end of August the registration had increased to 64,905 airplanes as shown in Table I, which also gives a breakdown of this total by rated horsepower classification. A part of this large increase of registration is due to the sale of surplus aircraft, which is discussed later in this article. To account for the sale of surplus aircraft, the training program available to discharged veterans and the normal increase in the utility of the airplane, it was necessary to modify the registration curve. A new predicted registration was obtained as

Table II

Shipments and Unfilled Orders for Personal Aircraft

Year	Shipments			Unfilled Orders	
	Total Units	1-2 Place	3-4 Place	1-2 Place	3-4 Place
1938	1,744	1,484	260*	.....	.....
1939	3,577	3,112	465*	.....	.....
1940	6,462	5,470	992*	.....	.....
1945	1,946	1,929	17	.....	.....
1946—January	1,187	1,172	15	.....	.....
February	1,204	1,180	24	.....	.....
March	1,969	1,919	50	.....	.....
April	2,263	2,219	44	26,778	12,553
May	3,001	2,921	80	32,704	12,764
June	3,380	3,202	178	33,073	13,852
July	3,358	3,087	271	32,475	15,264
August	4,656	4,189	467	31,504	14,897
September	4,001	3,504	497	30,286	17,333
Total	25,019	23,393	1,626		

* Indicates three to five-place planes for 1938, 1939 and 1940.

shown by the shaded area and upper line of the airplane registration curve. Taking these factors into account results in a predicted registration of 52,000 airplanes in the United States alone at the end of 1946, with this figure increasing to 160,000 airplanes at the end of 1950.

Airplane Production

The data on production for the same period as that for the registration of passenger cars, commercial trucks and civil aircraft are shown in Fig. 2. The method of analysis is the same as for Fig. 1. The accelerated rate of production is shown by the dash line of the airplane curves. This prediction indicates a total production for civil aircraft of the personal type of 28,000 for 1946, 42,000 for 1947, 43,200 for 1948 and 44,500 for 1949.

Actual production of personal type aircraft from January 1 to September 30 was 25,019 airplanes, as shown in Table II. If the industry maintains an average of 4000 airplanes per month for the remainder of the year, it will reach a total of 37,019 airplanes, which exceeds the estimate shown in Fig. 2 by a considerable margin. However, the months of October, November and December usually show a decrease in civil airplane sales, which may decrease production to less than 4000 per month and make the total for the year somewhat closer to the original estimate. These conditions may not prevail this year due to the extensive training program for veterans and the demand for aircraft to be exported to the Central and South American countries.

For the nine Personal Aircraft Council members listed in Table IV, the dollar volume of shipments in August was $8,554,000 which represents 3347 airplanes or 71.8 per cent of the total for that month. The average value was about $2550 per airplane. If the average value for all manufacturers in August was the same as for the nine listed companies, then the total value of shipments in August would be $11,900,000 for the 4656 airplanes shipped.

Unfilled orders of personal aircraft for the month of September were 47,619, of which 30,286 were for one and two-place planes and 17,333 for three and four-place planes, as shown in Table II. It is interesting to note that unfilled orders for one and two-place aircraft have decreased steadily since June, but have increased for the three and four-place aircraft except for the month of August.

Table III

Shipments of Personal One to Five Place Aircraft

Classification by Total Rated Hp

Year	Total Units	Units 1-70 Hp	Units 71-100 Hp	Units 101-165 Hp	Units Over 165 Hp
1938	1,744	1,371	61	149	163
1939	3,577	3,033	311	119	114
1940	6,462	4,852	1,041	176	393
1945†	1,946	.....	.....	...	...
	Total Units	**1-74 Hp**	**75-99 Hp**	**100-399 Hp**	**Over 399 Hp**
1946—January	1,187	1,047	125	15	...
February	1,204	939	241	24	...
March	1,969	1,479	440	50	...
April	2,263	1,675*	544*	44*	...
May	3,001	2,093	820	88	...
June	3,380	2,147	1,042	191	...
July	3,358	1,915	1,076	366	1
August	4,656	2,622	1,363	670	1
September	4,001	2,185	1,059	754	3
Total	25,019	16,102	6,710	2,202	5

* April Hp units are 1-69; 70-89; 100-249.
† Corresponding data not available for 1945.

Pilot and Student Registration

Evidence of the growing interest in personal airplanes and individual flying can be obtained from a study of the records on the number of student permits and pilot certificates issued by the Civil Aeronautics Administration. This information is shown in Fig. 3 for the period 1936 to 1946, with predicted registration extended to 1950. It is interesting to note that up to July 1 a total of 406,849 student permits and pilot certificates had been issued. Of this number, 143,717 were private pilot certificates; 192,839, commercial pilot certificates; 6048, airline pilot certificates and 64,245 student pilot permits. The rapid growth of aircraft registration and pilot and student certificates is self-evident from the chart. The continued increase of pilot certificates and student pilots during the war period is particularly noteworthy because it represents the continued interest in personal flying during the war period aside from the tremendous military aviation activity. It is this combined activity which is to a large degree responsible for the demand for personal type aircraft immediately after the war and at the present time.

The demand for aircraft can also be judged to a certain extent, from the ratio of the number of pilots to the number of airplanes in any one period of time. An analysis of this ratio for the period of 1931 to 1946 shows that in peacetime years, such as 1931 to 1938, the average ratio of pilots to airplanes was 2.19. This increased rapidly in the early prewar and war periods due to the civilian pilot training program sponsored by the CAA, the continued interest in civilian flying during the war and the complete absence of civil airplane production during the war. At the end of 1944 the ratio of pilots to airplanes was 6.02 and on July 1, 1946 the ratio was 5.96. The annual variation in this ratio is shown in Fig. 4. The high present value of the ratio of 5.96 suggests a high potential market for personal airplanes, particularly if the ratio of pilots to airplanes is to approach the prewar, peacetime value. (*Next page, please*)

Table IV

Shipments and Unfilled Orders

(excluding helicopters and gliders)

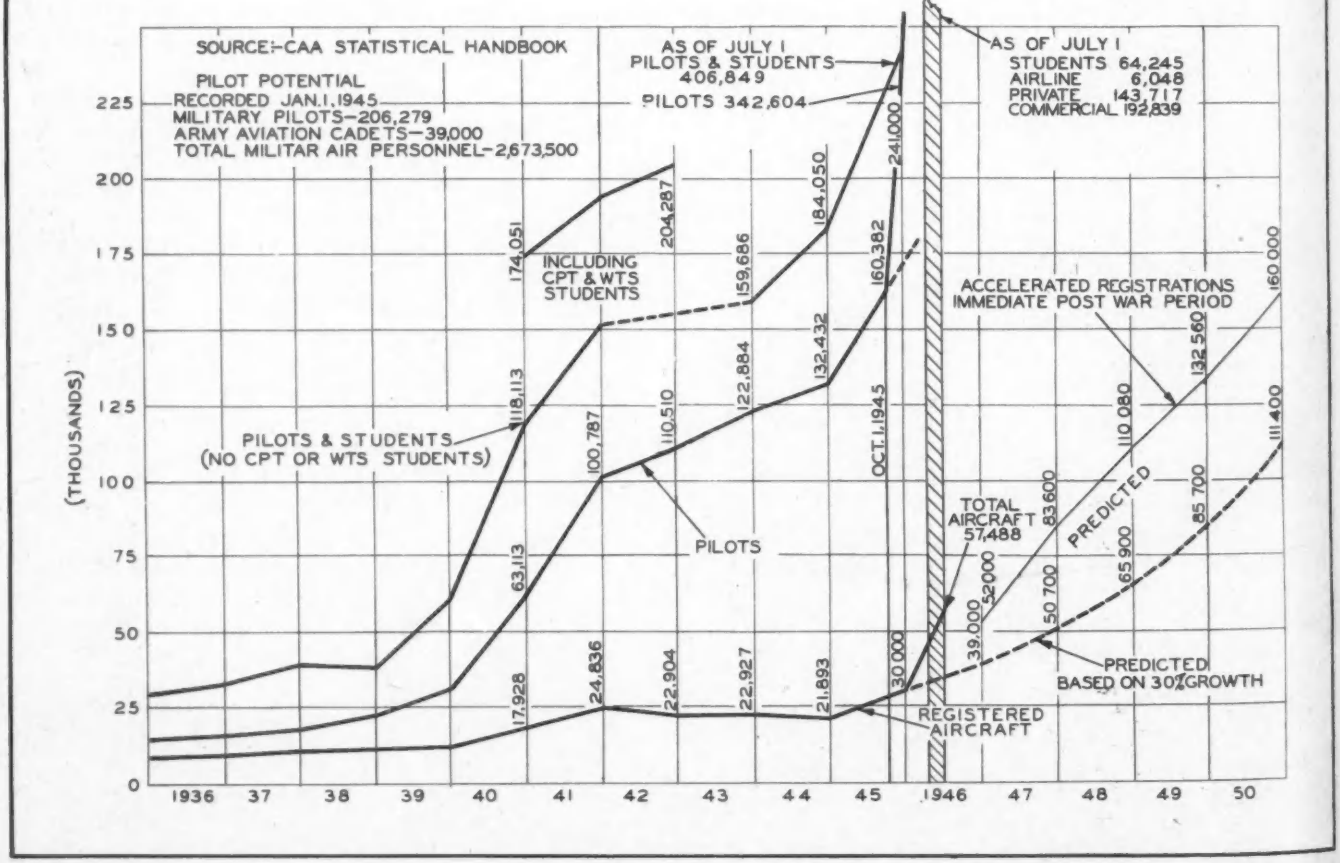
Company	Shipments				Unfilled Orders			
	Number		Value ($1000)		Number		Value ($1000)	
	August	July	August	July	August	July	August	July
Aeronca	798	793	$1,422	$1,444	4,462	4,189	$8,632	$7,780
Beech	20	20	1,228	1,172	53	48	3,228	2,867
Cessna	547	481	1,275	1,122	914	782	2,118	2,051
Luscombe	260	193	650	455	(na)	(na)	(na)	(na)
Piper	798	710	1,407	1,227	11,993	12,770	24,539	26,189
Republic	20	.....	98	(b)	5,126	5,150	(b)	(b)
Stinson	245	121	980	484	1,940	2,355	7,760	9,420
Taylorcraft	518	318	1,036	636	1,725	1,900	3,400	3,800
Texas Engineering and Mfg.	121	52	456	218	1,582	1,703	3,587	3,615
Total by Personal Aircraft Council Members Reporting	3,347	2,688	$8,554	$6,758†	27,795	28,897	$53,264†	$55,722†

(na)—Not available. (b)—Combined with total for airliners. †—Excludes Republic.
Source: Aircraft Industries Association.

The statistical data for the month of July support the predicted trend of the increase of pilot certificates and airplane production. In the month of July, 21,935 student certificates were issued by the CAA, registered aircraft increased to a total of 60,669, private pilots increased to a total of 149,785, commercial pilots increased to 195,735 and airline pilots to 6428, so that at the end of July there were 351,948 certificated pilots in the United States or over double the number of civil pilots on V-J Day. The ratio of pilots to airplanes reduced slightly to a value of 5.8 during July.

The interest in personal aircraft in various sections of the country can be studied by analyzing the distribution of registered aircraft, the distribution of the sale of surplus aircraft and the distribution of airports and other commodities between the various sections of the country. A distribution of this type is shown in Table V. In this table the United States is divided into nine sections representing (1) the New England States, (2) the Middle Atlantic States, (3) the South Atlantic States, (4) the East North Central States, (5) the East South

Fig. 3—A study of the increase in student permits and pilot certificates issued by the VAA, and the actual and predicted civil aircraft registrations from 1936 to 1950.



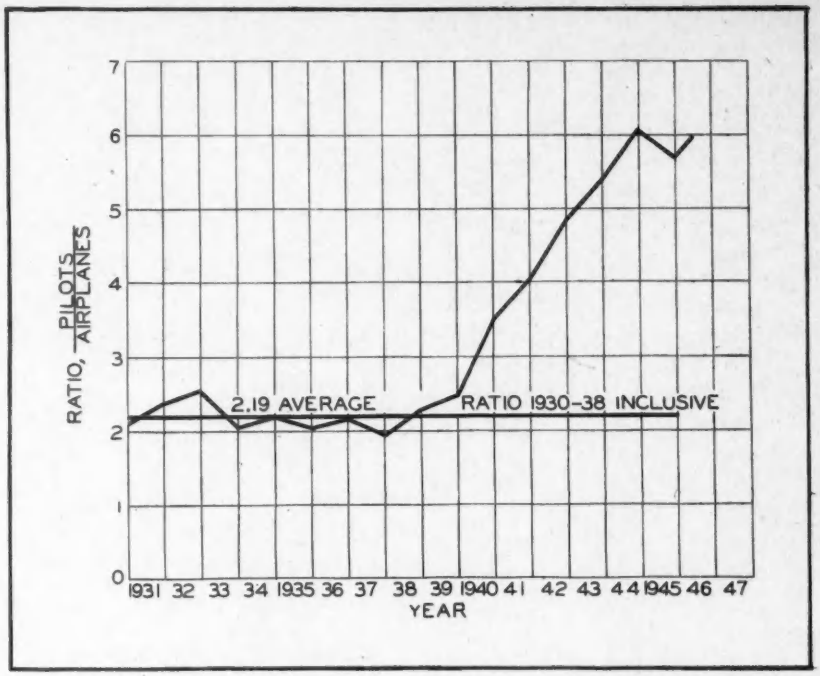
Central States, (6) the West North Central States, (7) the West South Central States, (8) the Mountain States and (9) the Pacific States. The states included in each of these sections are given in Table V.

The East North Central States lead in the registration of aircraft as of July 1, 1946 with a total of 10,861 or 18.88 per cent of all registered aircraft. The Pacific States are second in order with a total of 8279 registered aircraft or 14.4 per cent of the total.

In the distribution of airports as of December 1945 the West South Central States, which include Texas, have the largest number of airports for a total of 600 or 16.25 per cent of the total. The South Atlantic States are second with a total of 552 or 14.95 per cent and the East North Central States are third with a total of 527 or 14.29 per cent.

Much of the increase in airports in the south and especially Texas and Florida can be attributed to the Government training programs during the war. Funds which have been made available by the Federal Government for airport development will result in a material increase in airports throughout the country. These funds have been apportioned to the states in accordance to population ratio and to land and water area ratio. A total fund of $45,000,000 has been made available for the fiscal year 1947. Of this amount $30,822,750 is available for direct airport expenditures. The amount apportioned to each state has to be matched by the individual state before the funds are made available to them. Under this system, the total amount which could become available in the 1947 fiscal year would be double the Federal fund or $61,645,500. The distribution of the Federal fund in accordance with the formula used by the Government is also shown in Table V. Under the Government formula the Mountain States will receive the largest amount as represented by the sum of $4,784,985 or 15.54 per cent of the total. The East North Central States are next in order with an apportionment of $4,620,102 or 14.98 per cent of the total. The proposed airport program should be of material benefit in increasing the utility of the personal airplane, because it will practically double the number of airports which are available today. Many states have already drawn up master airport plans and are active in making the necessary arrangements to obtain the required state airport fund to match that supplied by the Federal government.

Fig. 4—The trend in the ratio of pilots to airplanes.



Hangar Facilities

At this point a word of caution in regard to airport expansion should be introduced, because an airport program without provision for hangar and service facilities is only half the answer.

The increase in airplane registrations has been so rapid that practically all airports find themselves very short of suitable building facilities for the proper housing of the airplanes stationed at these airports. In many cases even suitable buildings for the proper servicing of aircraft are lacking. It is not at all uncommon when visiting municipal, county, state, federal and private airports to see large numbers of airplanes parked outside of hangars along the servicing boundary line and in the parking areas in addition to hangars completely filled with airplanes packed as close together as possible. This close packing of airplanes results in much unnecessary damage, unnecessary cost and detracts from utility. Airplanes parked outside, day and night, for long periods show much unnecessary deterioration and higher depreciation rates than are necessary.

In many sections of the country, during the winter season, the necessity to park airplanes outside without proper protection against the weather will result in hard starting and additional deterioration from the weather elements. These conditions must be corrected if the utility of the personal airplane is to be maintained and increased in scope.

Housing for airplanes is being delayed because of material shortages such as is the case in other building programs. The shortage of steel is the principal drawback. All manufacturers of prefabricated hangars are loaded with big backlogs of orders, but are only able to supply a small fraction of the demand. The same situation exists in the case of contracts for permanent type hangar structures to be built up at the airport site. This situation definitely requires attention, and the whole aircraft industry through its associations should take an active part in promoting the building of more hangar facilities and to obtain some priority for the necessary materials.

(*Next page, please*)

Information on the distribution of new airplane sales by states has not yet become available. However, a good idea of the demand for personal type airplanes can be obtained by studying the data released by the War Assets Administration on the sale of surplus aircraft. Up to May 20, 1946, the WAA had sold a total of 23,690 surplus airplanes. Of this number, 5376 or 22.7 per cent of the total were assigned to the CAA pilot training program, 418 or 1.76 per cent were sold to foreign countries and 25 or 0.105 per cent were sold in United States territories. The remaining number of 17,879 were sold to various organizations and individuals. The distribution of these sales by section of the United States is presented in Table V. The largest number represented by 3729 or 15.75 per cent were sold in the Pacific States, the second in order were sold in the West South Central States with a total of 3157 or 13.33 per cent and the third in order were sold in the East North Central States with a total of 2613 or 11.02 per cent. The surplus airplane sales are represented by many types of airplanes from the light liaison or grasshopper type to very heavy bombers. The types of airplanes which can be considered similar to those of the personal airplane type are the liaison, primary trainers, basic trainers, advanced trainers and light transports. The distribution of these airplanes by number and percentage of total are shown in Table VI. It will be noted that the largest number of surplus aircraft sold is represented by the primary trainers with a total of 8702 or 46.2 per cent of the total. The liaison type of airplane is next in order with a total of 3359 or 17.83 per cent. This is followed closely by the basic trainer with a total of 3351 or 17.75 per cent. These figures do not include the 5376 surplus airplanes which were sold for the CAA pilot training program.

An analysis of the sale and distribution of surplus airplanes is of particular interest, because it furnishes information on a good potential replacement market. The program in which the WAA has been engaged has also accelerated the interest in the sale of used airplanes and the establishment of a recognized used

Table V

Sectional Group*	Registration of Civil Aircraft (July 1, 1946)	Airports (1945)	Federal-Aid Funds Airport Program (Fiscal Year 1947)	Distribution of Surplus Airplane Sales to 5/20/46	Pilot Certificates (1945)	Passenger Car Registration (1941)
New England:						
Units	2,146	150	$1,332,212	323	7,015	1,867,560
Per Cent Total	3.73	4.06	4.31	1.36	4.96	6.34
Middle Atlantic:						
Units	7,237	340	$3,762,061	1,643	21,300	5,539,441
Per Cent Total	12.58	9.20	12.20	6.94	15.08	18.84
South Atlantic:						
Units	7,679	552	$3,501,534	2,472	16,391	3,230,915
Per Cent Total	13.37	14.95	11.35	10.43	11.59	10.98
East North Central:						
Units	10,861	527	$4,620,102	2,613	23,074	6,903,348
Per Cent Total	18.88	14.29	14.98	11.02	16.31	23.50
East South Central:						
Units	2,480	179	$2,172,682	753	5,814	1,391,290
Per Cent Total	4.32	4.85	7.05	3.18	4.11	4.72
West North Central:						
Units	6,906	442	$4,167,263	2,107	17,682	3,485,220
Per Cent Total	12.02	11.98	13.51	8.82	12.52	11.84
West South Central:						
Units	7,761	600	$3,718,400	3,157	17,559	2,475,031
Per Cent Total	13.50	16.25	12.07	13.33	12.41	8.41
Mountain:						
Units	3,578	494	$4,784,985	1,082	8,598	1,037,545
Per Cent Total	6.22	13.38	15.54	4.57	6.10	3.52
Pacific:						
Units	8,279	408	$2,763,511	3,729	22,384	3,487,918
Per Cent Total	14.40	11.04	8.97	15.75	15.82	11.85
Foreign and Territorial:						
Units	561	.....	.....	413†	1,463	.....
Per Cent Total	0.975	.....	.....	1.76	1.10	.....
Total all Units	57,488	3,692	$30,822,750	23,698	141,280	29,418,313

†—Foreign only—add territorial, 25 units or 0.105 per cent total; and CAA pilot training program of 5376 units or 1.76 per cent total.

*—States in Sectional Groups are as follows: New England—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut. Middle Atlantic—New York, New Jersey, Pennsylvania. South Atlantic—Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida. East North Central—Ohio, Indiana, Illinois, Michigan, Wisconsin. East South Central—Kentucky, Tennessee, Alabama, Mississippi. West North Central—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas. West South Central—Arkansas, Louisiana, Oklahoma, Texas. Mountain—Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada. Pacific—Washington, Oregon, California.

plane market. The used plane market had its origin long before the war, but the complete absence of the manufacturing of new civil aircraft during the war period created a demand for airplanes which could not be met by the manufacturers and accelerated the activity to the point where at present it almost rivals the new plane sales. As a result, used planes are selling at prices which are only a small amount below the price of new aircraft.

Active pilot certificates are also a measure of the demand for airplanes and the distribution of these certificates by section of the country furnishes information on how this demand may vary. The latest information which is available on the distribution of pilot certificates is for the period ending December 1945. On this date, the total number of pilot certificates was only 141,280 compared to 351,948 on July 31, 1946. To obtain some indication of the pilot distribution, the data for 1945 was used and this is given in Table V. Based on these data, the East North Central States showed the largest number of certified pilots with 23,074 pilots or 16.31 per cent of the total. The Pacific States were next in order with a total of 22,384 or 15.82 per cent. The Middle Atlantic States were third with 21,300 pilots or 15.08 per cent of the total. Personal flying operations on the East and West Coasts were restricted during the war period. Consequently, the number of pilots shown for these states at the end of 1945 is not necessarily in the same order as they may exist at the present time, because the restrictions have been removed since this date. New pilot registrations are accumulating at a very rapid rate and it may be some time before an accurate distribution by states is available.

Information on the probable distribution of new and used airplane sales and airplane registrations can also be obtained by studying the distribution of other commodities such as automobiles, motor boats and other items whose demand is governed by utility to the individual as a part of his business and pleasure activities. The distribution of passenger car registrations for the year 1941 has been selected as one index. This distribution appears in Table V. It is interesting to note that the registration of passenger cars by states follows a pattern which is very similar to that of registered civil aircraft. The East North Central States lead in car registrations with 6,903,348 or 23.5 per cent of the total. The Middle Atlantic States are second with 5,539,441 or 18.84 per cent of the total and the Pacific States are third with 3,487,918 or 11.85 per cent of the total.

Personal Airplane Manufacturers

At the present time there are 38 manufacturers of aircraft in the United States and two in Canada, who are either in production or who have announced designs ready for production of airplanes which will meet the requirements of the personal airplane market. The names and addresses of these manufacturers are listed in Table VIII. Of this total group, only 17 are in actual production in the United States and two in Canada. Many of the manufacturers have been slow in producing airplanes in quantity due to the introduction of completely new designs, plant conversions and material shortages. The largest production has occurred in the two-place category and with one or two exceptions, the designs of these airplanes were practically identical with the prewar models. It is interesting to note that about 95 per cent of the airplanes produced in 1946 were made by only six manufacturers and that the two largest manufacturers produced over 45 per cent of the total. According to the Aircraft Industries Association release, Aeronca Aircraft Corp. and Piper Aircraft Corp. lead the field in the number of airplanes produced with each shipping 798 airplanes in the month of August against the July figures of 793 for Aeronca and 710 for Piper. The Aeronca shipments in August represent a value of $1,422,000 and the Piper shipments $1,407,000. The number of airplanes shipped and their value for the Personal Aircraft Council members are shown in Table IV. To the data in this table should be added the shipments and value for Engineering and Research Corp., which manufactures the Ercoupe two-place, two-control airplane and which in August occupied first place in dollar value with an amount of $1,681,000, and third place in shipments of 650 airplanes.

Many of these manufacturers were fairly well established in this field prior to the war, although their activities were relatively minor in extent compared to their present production. This is especially true when one considers that in the best prewar year, which was not affected by the Government programs, the personal airplane industry built fewer airplanes in the whole year than they are now building in one month. The extent of the relative prewar production and the present production can be seen in Tables II and III. These figures also supply information on the number of airplanes built in each class as shown by the power range and the seating accommodations.

In its present state of growth, the personal airplane manufacturing industry differs from other manufacturing activities in that it is not concentrated in any

Table VI

Cumulative Sales of Surplus Airplanes

(As of May 31, 1946)

AIRPLANE TYPE	Number Sales	Per Cent Sales
Liaison	3,359	17.83
Utility cargo	356	1.89
Light transports	1,143	6.06
Medium transports	657	3.49
Heavy transports	200	1.06
Primary trainers	8,702	46.20
Basic trainers	3,351	17.75
Advanced trainers	928	4.93
Reconnaissance	48	0.25
Fighters	48	0.25
Light bombers	23	0.12
Medium bombers	27	0.14
Heavy bombers	3	0.02
Total sold by WAA	18,845	
Sold for RFC by CAA (for Civil Pilot Training program)	5,376	
Total Sales	24,221	

one city or any one specific district of the country, as is found in the automobile industry and other similar groups. Accordingly, it is interesting to study this condition with respect to the supply of raw materials and the distribution of the finished product.

The efficient distribution of airplanes can be determined from the location of the main manufacturing plants and the assembly plants. An analysis of this condition can be made from Table V showing airplane and pilot distribution, and Table VIII, which lists the personal plane manufacturers and the sections of the country in which they are located. It is interesting to note that four of the largest manufacturers of the smaller type of personal airplanes are located east of the Mississippi River and in those districts represented by the largest number of pilot registrations, aircraft registrations, and automobile registrations. Several of the manufacturers of large commercial and military aircraft have shown extensive interest in the personal airplane market and at least two of these are now in production on a moderate scale. There is also an increasing activity on the part of manufacturers located in Kansas and the West South Central States and the growth of the industry should be watched with respect to these districts.

A study of the location of sources of supply for the manufacturing of personal aircraft furnishes some of the reasons why the greater number of these manufacturers are located in the eastern section of the country. The concentration of these sources of supply in the East North Central and Middle Atlantic States is noteworthy, because their close proximity to the airplane manufacturing plants result in lower material costs, less time required for material shipments, and better control over deliveries—especially during periods in which supplies are critical. Under present conditions of supply, it is not at all unusual to see the airplane manufacturer pick up materials and other items required in the manufacturing processes of the airplane by means of their own trucks or by arrangement with local motor freight services.

Airplane Prices

The list price of personal type airplanes of a two- and four-place arrangement varies from approximately $2000 to $7500. The individual prices depend upon the type of design and construction, the seating arrangement and the performance. In the two-place category, the lowest price is represented by the conventional fabric covered, strut-braced airplane without starter and generator and with a minimum number of accessories. This carries a price tag of about $2000. The high-priced airplane is represented by one of modern, all metal construction with retractable landing gear, electric starter and generator, radio and other advanced features and is priced at about $5000. The majority of the two-place designs are, however, below the $4000 mark with a number of designs of good performance incorporating starter and generator, radio and other desirable accessories available

Table VII

Personal Aircraft—1946 Production

Price Comparisons With Weight & HP

Airplane	List Price	Gross Weight, Lb	List Price Per Lb Gross Wt.	Empty Weight, Lb	List Price Per Lb Empty Wt.	Hp	List Price Per Hp	Useful Load, Lb	List Price Per Lb Useful Load
Aeronca—Chief	$2,585	1,250	$2.07	725	$3.56	65	$39.75	525	$4.92
Aeronca—Champion	2,095	1,220	1.72	710	2.95	65	32.20	510	4.11
Luscombe—Silvaire—8A	2,995	1,200	2.50	720	4.16	65	46.10	480	6.25
Piper—Special	2,010	1,220	1.65	680	2.96	65	30.95	540	3.72
Taylorcraft—Standard	2,695	1,200	2.25	730	3.70	65	41.50	470	5.74
*Aeronca—Chun	3,120	1,340	2.33	825	3.78	75	41.60	515	6.06
Ercoupe	3,450	1,260	2.74	750	4.60	75	46.00	510	6.77
Funk—Bee	3,695	1,350	2.74	800	4.62	75	49.30	550	6.72
All-American—Ensign	3,495	1,550	2.26	1,000	3.50	85	35.30	550	5.45
Cessna—120	2,495	1,450	1.72	770	3.24	85	29.35	680	3.67
Cessna—140	2,995	1,450	2.06	890	3.36	85	39.60	660	5.10
*Commonwealth—Skyranger	2,750	1,450	1.90	850	4.23	85	32.35	600	4.58
Culver—Model V	3,950	1,600	2.47	1,060	3.73	85	46.50	540	7.32
Globe—Swift—GC-1A	3,495	1,570	2.23	940	3.72	85	41.10	630	5.55
Luscombe—Silvaire—8E	3,795	1,400	2.71	850	4.46	85	44.65	550	6.90
Piper—Super Cruiser	2,905	1,750	1.66	1,000	2.91	104	27.95	750	3.88
*Skycraft—Model 246	4,200	2,100	2.00	1,390	3.02	115	36.50	710	5.92
*Globe—Swift—GC-1B	4,995	1,710	2.57	1,110	3.96	125	35.20	600	7.33
Bellanca—Cruisair Sr.	4,500	2,100	2.14	1,210	3.72	150	30.00	890	5.06
Cons.-Vultee-Stinson—Voyager	5,270	2,230	2.36	1,224	4.31	150	35.10	1,006	5.23
*Fairchild—Warner	8,500	2,562	3.32	1,613	5.26	165	51.50	949	8.95
Commonwealth—Trimmer	5,985	2,200	2.72	1,470	4.07	170	35.20	730	8.20
Fairchild—F24—Ranger	8,875	2,562	3.46	1,650	5.38	175	50.65	912	9.74
Johnson—Rocket	5,000	2,450*	2.04	1,550*	3.22	185	27.00	900	5.55
North American—Navion	6,100	2,570	2.38	1,551	3.93	185	33.00	1,019	5.99
Skycraft—Model 446	5,800	2,800	2.07	1,510	3.84	190	30.50	1,290	4.50
Republic—Seabee	4,495	3,000	1.50	1,950	2.31	215	20.90	1,050	4.28
Beech—35	7,345	2,550	2.88	1,490	4.93	165	44.50	1,060	6.93
Waco—Aristocraft	9,880	3,130	3.16	2,046	4.83	215	45.90	1,084	9.12

* Approximate.

at prices between $2500 and $3500.

Production of airplanes of the four-place type is growing with several new interesting designs just beginning to come off the production lines. List prices vary from about $4500 to $7500. All of these designs have electric starter and generator as standard equipment and make provision for suitable radio installations and such accessories as may be desirable for cross-country operations.

Specific information on list prices and other useful items is given in Table VII for those airplanes on which data have become available. Wide variations in unit prices exist in practically all of the horsepower classifications. This illustrates wide variations in design, production methods, materials, accessories and general utility. The table will be found useful as a means of studying the variations in price due to production methods, materials, accessories and other cost items. For example, in the 85 hp classification, which is a popular power range for the medium performance, two-place airplane, we find that the list price per lb of empty weight of the airplane varies from about $3.25 to 4.50 per lb. In the same classification the list price in dollars per lb of useful load varies from about $3.75 to $7.40 and the purchaser pays a list price of about $29 to $47 per hp, although the same model engine is used in both airplanes. It can be predicted that as production catches up with demand and competition becomes keener, prices will tend to stabilize more towards the lower figures than the higher ones. This adjustment will be aided by the introduction of better production methods, lower material costs and lower distribution costs, all made possible by the increased volume of production. In this respect the airplane is no different than other commodities with or without price ceiling control and therefore, it can be assumed that airplane prices will decrease somewhat in the same order as the prices of other commodities.

(End of Part I. Part II will appear in an early issue of AUTOMOTIVE AND AVIATION INDUSTRIES).

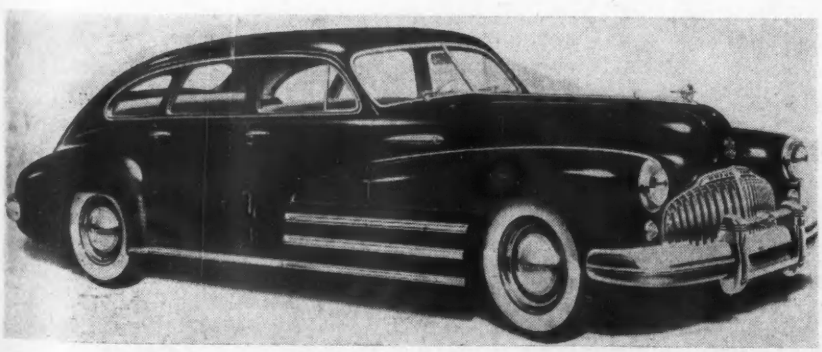
Table VIII

Personal Aircraft Manufacturers

SECTION AND COMPANY NAME †	ADDRESS
MIDDLE ATLANTIC	
Canadian "Cub" Aircraft Ltd.	Hamilton, Canada
Commonwealth Aircraft Inc.	Valley Stream, N. Y.
Fleet Aircraft Ltd.	Fort Erie, Canada
Grumman Aircraft Engineering Corp.	Bethpage, N. Y.
Piper Aircraft Corp.	Lock Haven, Pa.
Republic Aviation Corp.	Farmingdale, N. Y.
SOUTH ATLANTIC	
Bellanca Aircraft Corp.	New Castle, Del.
Engineering and Research Corp.	Riverdale, Md.
Chester L. Eshelman Co.	Baltimore, Md.
EAST NORTH CENTRAL	
Aeronca Aircraft Corp.	Middletown, Ohio
Applegate & Weyant Engineering Co.	Tecumseh, Mich.
Consolidated-Vultee, Stinson Div.	Wayne, Mich.
Meyers Aircraft Co.	Tecumseh, Mich.
Midwest Aircraft Co.	Wyandotte, Mich.
Taylorcraft Aviation Corp.	Alliance, Ohio
Waco Aircraft Co.	Troy, Ohio
EAST SOUTH CENTRAL	
Tennessee Aircraft, Inc.	Nashville, Tenn.
WEST NORTH CENTRAL	
Beech Aircraft Corp.	Wichita, Kan.
Cessna Aircraft Co.	Wichita, Kan.
Culver Aircraft Corp.	Wichita, Kan.
Funk Aircraft Co.	Coffeyville, Kan.
Le Mars Mfg. Co.	Le Mars, Iowa
WEST SOUTH CENTRAL	
Aerobat Aircraft	Brownsville, Texas
Fairchild Engine & Airplane Corp.	Dallas, Texas
Globe Aircraft Corp.	Fort Worth, Texas
Johnson Aircraft, Inc.	Fort Worth, Texas
Luscombe Airplane Corp.	Dallas, Texas
Spartan Aircraft Corp.	Tulsa, Okla.
Southern Aircraft	Garland, Texas
MOUNTAIN	
Call Aircraft Co.	Afton, Wyoming
PACIFIC	
All-American Aircraft, Inc.	Long Beach, Calif.
Curtiss-Wright Industries	Los Angeles, Calif
Max B. Harlow	Alhambra, Calif.
Hockaday Aircraft Corp.	Burbank, Calif.
Jarvis Manufacturing Co.	Glendale, Calif.
Nelson Aircraft Corp.	San Fernando, Calif.
North American Aircraft Corp.	Los Angeles, Calif.
Puget Pacific Planes, Inc.	Tacoma, Wash.
Skylark Manufacturing Co., Inc.	Venice, Calif.
Stearman-Hammond	Oakland, Calif.

†—See Table V for individual states in each section.

Buick Begins Production on Series 40-Specials



BUICK Division of General Motors will begin production this month, of its Series 40 Special cars, on a 121-inch wheelbase.

This was announced by Harlow H. Curtice, General Motors vice president and Buick chief executive, who said that the Series 40 cars, to be produced in two body types, are 1946 models in the company's lowest priced group. The two models are the six-passenger four-door sedan, and the six-passenger two-door sedanet and are powered with the valve-in-head, "Fireball" engine.

Rototiller Engine

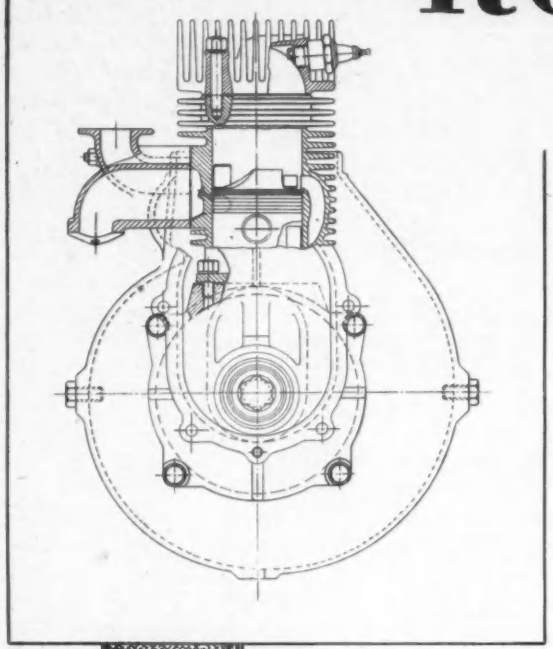


Fig. 1—Rear view of the Rototiller Model B1-6R five-hp engine, with cylinder cutaway showing details of the die-cast aluminum piston, the intake and exhaust ports in the cylinder wall, and the cored passage for the transfer port.

THE Rototiller farm machine now being produced by the Graham-Paige Motors Corp. is powered by the Model B1-6R engine—a single cylinder, two-stroke, aircooled engine built by Bell Aircraft Corp. to Graham-Paige specifications. It has a bore of 3.0 in., a stroke of 3¼ in., and a displacement of 23 cu in. The compression ratio is 6.1, and at 2400 rpm the engine develops five hp. The maximum torque of 160 lb-in. is developed at 1400 rpm.

Figs. 1 and 2 show sectional views of the Rototiller engine. The crankcase, intake and exhaust pipe connection, cylinder, and cylinder head are of cast iron. The die-cast aluminum alloy piston is fitted with three compression rings. Snap rings hold the full-floating type piston pin in position. The connecting rod, which is a steel forging hardened on the wearing surfaces, is fitted with needle roller bearings at the upper and lower ends. A large aluminum flywheel with integral fan blades serves as a blower to force air over the cooling fins on the cylinder and cylinder head.

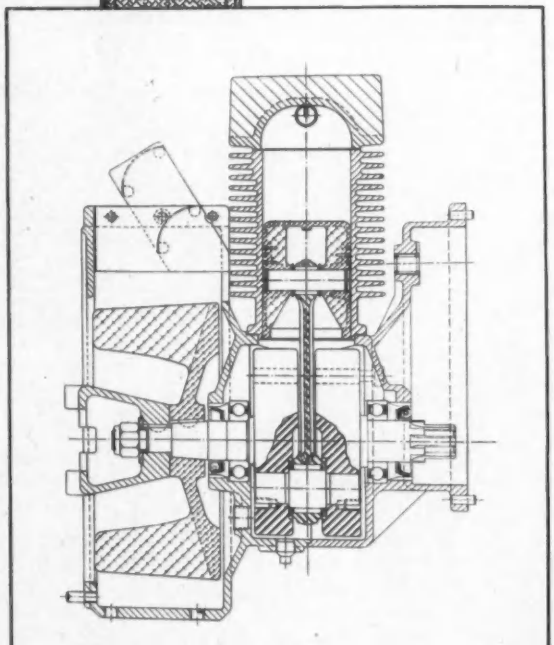


Fig. 2—Longitudinal section of the Rototiller two-stroke cycle engine showing details of the three-piece crankshaft, piston, connecting rod, and other parts. The fan-type aluminum flywheel at the left provides cooling. Starting dog is at the extreme left.

To facilitate engine assembly, the balanced and counterweighted crankshaft assembly is made in three pieces—the front and rear sections, and the crank pin. The sections are held in place by means of the studs through the crank pin and crankshaft sections, as shown in Fig. 2. The crankshaft is supported by ball bearings at each end which are so arranged as to carry thrust on the rear bearing. The crankcase is sealed against leakage by means of the seals outside of each main bearing mounting. Lubrication is afforded by the fuel which is a mixture of gasoline and oil.

A new reverse gear is available for the Rototiller to facilitate its use in confined quarters. It is designed as a packaged unit and adds three in. to the length of the transmission.

The addition of the reverse gear gives the Rototiller three speeds: three-quarters of a mile per hour in reverse, three-quarters of a mile per hour tillage speed, and a mile and a third per hour road speed.

More than 10,000 Rototillers have been built in less than six months of production at the Willow Run plant, and Graham-Paige has received approximately 100,000 orders for the machines, according to a company statement.

Airbriefs

by Robert McLarren

Jet Science

It has recently been suggested that greater effort be expended in increasing pressure ratios in turbojet engines as a method of providing additional power. However, with current designs this can be accomplished only by either increasing the compressor speed or the mass-flow of the air. That this leads to inefficiencies is evident from the fact that a definite relationship exists between pressure ratio and optimum temperature. An increase in pressure ratio creates an accompanying increase in temperature with all its dangers. Further, any variation in pressure ratio or temperature from the optimum creates losses in efficiency.

Another consideration is the fact that in the event that increased pressure ratio produces temperatures as high as the strength of the metal, then fuel for combustion cannot be added without running grave dangers. Where efficiency is of secondary importance, such as in a military fighter plane, for example, increased pressure ratios producing greater power would appear to be worthwhile. Where efficiency is of maximum importance, such as in a commercial transport plane, increased pressure ratios can only mean reduced efficiencies, greater fuel consumption and shorter engine life.

Whittle Reports

Following his return to England from a three-month study of American aviation, Air Commodore Frank F. Whittle reported that the United States was several years behind the British Empire in jet propulsion progress. He was surprised, however, that the overhaul period for turbojet engines in this country averaged about 270 hours as compared to about 50 hours in England. He felt that our greatest difficulty was in combustion chamber design and fabrication (as used in versions of his own centrifugal-flow design). Gas turbine-propeller design in the United States is far behind that in England, he said, although the situation is quite the reverse in the ramjet field. Whittle deplored the fact that we are concentrating the great majority of our present and future effort in the axial-flow field. This trend, however, follows research results that point toward the axial-flow design as the superior in efficiency and simplicity.

New Wing Structure

The problem of building a "smooth" wing may not appear complex to the layman but to the aircraft industry it is critical. The introduction of "laminar flow" sections on fighter and bomber types has rendered smooth skin structures a necessity. Tests during the war revealed that normal manufacturing tolerances and conventional workmanship resulted in comparatively "rough" wings which, in one notable case, nearly destroyed all the advantages of the laminar flow airfoil section. To meet this problem, Armstrong-Whitworth in England has devised a new structure which is built from the "outside-in", rather than as is customary in the United States where tolerances augment from the inside out forcing the exterior to take the error. Armstrong-Whitworth uses a thick skin further stiffened by corrugated sections, the combination taking the whole of the bending and shear loads in flight. The wing is built in two halves, divided laterally, in accurately contoured forms into which the skin and corrugations are clamped. Tests of the new wing produced laminar flow in the National Physics Laboratory high-speed wind tunnel. American manufacturers will be forced to attack the problem from a similar original viewpoint as repeated attempts at close-tolerance fabrication have proved excessively costly with conventional configurations.

Aviation Corp. Realignment

In a series of corporate adjustments, Aviation Corp. has about completed a new structure that would remove it entirely from the aviation field in favor of the transportation and consumer goods fields. Avco has taken over Crosley Corp., New Idea, Inc. and American Central Manufacturing Corp. Crosley manufactures home radios, refrigerators and other consumer items in addition to operation of radio station WLW in Cincinnati, Ohio. New Idea, Inc. manufactures farm implements and machinery and was owned 90 per cent by Avco. American Central manufactures kitchen sinks, cabinets and automobile bodies. In addition, Avco owns ACF-Brill Motor Co. and Hall-Scott Motor Car Co. Observers believe that this realignment is preparatory to sale of Consolidated Vultee Aircraft Corp. to Lockheed Aircraft Corp., a move recently rumored.

Lightplane Jet

Few engineers see any future application of the turbojet engine to the lightplane for the obvious reason that efficiency is extremely low at such speeds (90-150 miles per hour). However, a recent invention shows interesting possibilities in the wedding of these two aviation elements. It consists of a pinwheel arrangement in which the jet tailpipes radiate out from a central supply to nozzles at a 45 deg angle. When combustion begins, this pinwheel rotates and delivers the jet in a path similar to that of a propeller helix. Thus, the high velocity of the jet pipe acts as the fuselage of a highspeed plane. The basic requirement that the differences between the jet speed and the vehicle speed to be a minimum is therefore accommodated. In addition, the 45 deg angle of the nozzles provides thrust for propulsion of the plane, which can be accomplished efficiently at speeds of less than 100 mph. Through the use of this "jet component" idea, rather than a full jet, it is entirely possible that a jet lightplane can prove practical.

Promising Helicopter

One of the most original and astute approaches to the helicopter problem is being made by Jean de Chappedelaine, French engineer now developing a new design in Reading, Pa. In forward flight a considerable difference in air velocity exists between those of the advancing blade and the retreating blade in a helicopter, the former moving against the wind, the latter with the wind. A major problem in the past has been to create uniform lift on both blades so that the helicopter will remain level laterally while in flight. This has been accomplished by increasing the angle of the retreating blade and decreasing the angle of the advancing blade, thereby creating equal lift on both blades. However, as the angle of the retreating blade is increased it approaches and frequently reaches the stalling angle, resulting in loss of lift, increased drag and unstable pitching moment on the blade.

M. de Chappedelaine has proposed boundary layer control as a remedy for this situation. His design contains a simple venturi tube in each blade tip.

(*Turn to page* 80, *please*)

Looking F

Part Two

Combustion Chamber, Past, Present and Future

DURING the days of awakening on combustion chamber shapes, 1925-1932, when Janeway, Ricardo, and Whatmough were telling us about what goes on in the combustion chamber, these men agreed that the F-head was the only head with broad limits for development. Fig. 3 shows early diagrams made in 1929 which already incorporated some features that bear present consideration. From our own records we find a statement published in the SAE Journal in 1930 referring to A in Fig. 3.

"Here is a new type of Ricardo combustion chamber for high power engines. Primarily this chamber is intended to have a pent roof contour similar to the highly efficient overhead camshaft type used in aircraft engines.

Ricardo claims this chamber is more compact than the ordinary chamber of turbulent heads and for this we believe it would be entirely too rough for passenger car engines. However it may be modified. In this country one of the largest users of F-heads has just discarded it while another large manufacturer has adopted it. Surely this valve arrangement with its attendant cooling possibilities is most ideal. I have always believed that the ideal passenger car engine can be made with this chamber, because of the possibility of controlling the area of the flame front, its improved volumetric efficiency and its detonation control possibilities." This statement would be true of this chamber today.

Examining the anti-detonation opportunities of the F-head we see that both Ricardo and Whatmough were well aware of the value of the intake valve head as a heat absorber for cooling the last gas to burn. This principle has been used particularly in this country by Chevrolet since 1932 in their diagonal head, C in Fig. 3.

Today, with engines being designed to operate on fuels all over the world, we are forced to dig deeper into the elements of anti-detonation with higher compression ratio, and we find today that the intake valve head may operate with a higher temperature than the walls or roof of the chamber in the quenching zone. Hence, instead of adding to the effectiveness of the quenching ability we may add nothing, and sometimes reduce the effectiveness. If, however, the valve is outside the quench zone where metal temperatures are higher than the intake valve head, then we gain in quench effect since we then do have the effect of the intake valve plus the quench area. This can only be done effectively in a F-head without materially adding width of block and head since with the overhead valve the space between valves must be maintained. If the quench area is sacrificed then the anti-detonation is sharply limited.

With regard to combustion shock it is necessary to understand that the chamber shape may control shock. The reaction to combustion roughness is deflection of the crankshaft, the crankcase, and distortion of bearing surfaces and the tossing about of components attached to crankshaft. It must be understood that combustion shock bears no relation to detonation. We may have an engine detonating badly and yet not be harsh, bumpy, or rough. The detonation wave involves a small portion of the burning gas which has its own set of motions and phenomena. It is like wheels within a watch, wherein the watch can be

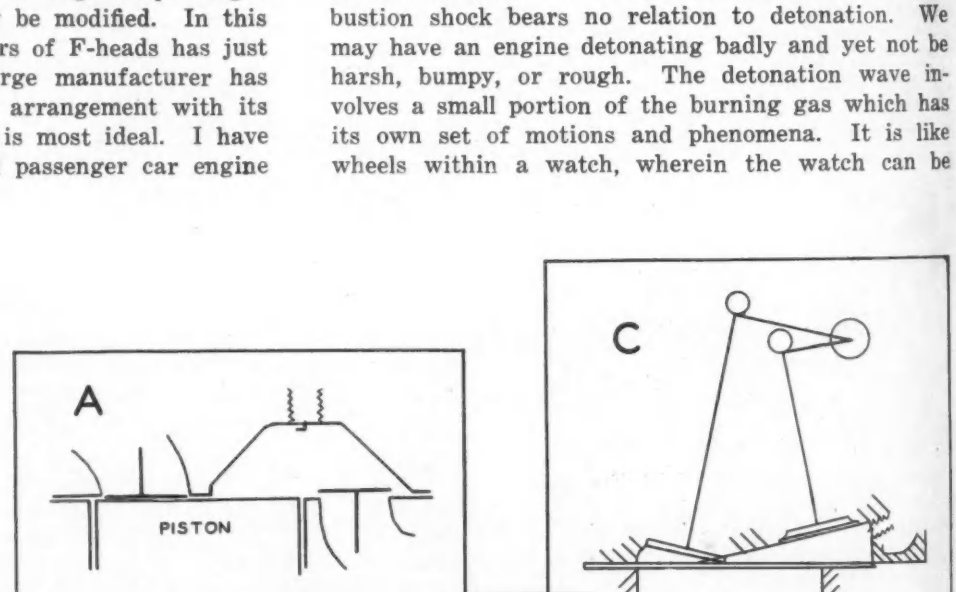


Fig. 3—An early concept of the F-head by Ricardo is sketched in A. B is Whatmough's idea of the F-head. Chevrolet during 1933-1940 used the valve arrangement shown in C.

Forward to Future Automobile Engines

By Alex Taub

Alex Taub Associates

moved around or held quietly while the wheels jump around and are not externally felt. This analogy is more convenient than actual because although detonation does not deflect the shaft because of its relative instantaneous progress it does crack pistons and spark plugs.

In combustion roughness we are dealing with the main-body of combustion which has volume in the charge and therefore pressure as well as a respectable velocity. Detonation has low volume in its charge although its reaction velocity is tremendous. The pressure rise of detonation is so rapid that we are only now becoming able to photograph it directly. However, fortunately it involves only one or two per cent of the total combustion volume. Low volume low distress, high volume high distress.

This is the principle we have used and recommend to control combustion roughness. We have a pressure in the chamber at ignition and we have a maximum pressure after ignition. This may be 150 to 550 psi, or 200 psi to 750. Without question, the maximum pressure is the troublesome element, and perhaps we should learn to adopt the principle of Diesel engine development where after the engine is built considerable work must go on to obtain the maximum bmep for the minimum max-pressure. This is the way to obtain a Diesel engine that does not audibly rattle its bones. Incidentally, it is always good to remember that a 100 bmep Diesel requires the same bearing protection as a 275 bmep spark ignition engine. The maximum pressures are the same. However, the Diesel has a very rapid rate of pressure rise with a large lag and the spark ignition engine even though relatively bad is very slow compared to the Diesel.

Here we have high rate of rise, high distress; low rate of rise, low distress. Our problem is to raise the pressure from compression pressure to maximum pressure at a rate that will generate the least amount of wild kinetic energy that will bend and toss the rotating and stationary supports. Janeway, in 1928, stated that if the pressure was applied too suddenly then the parts were deflected and the force, stored up in the deflected parts, created the roughness phenomena when they moved practically twice the original or deflected distance in the return motion. This principle has been recently supported but the degree has been questioned.

Since we must deal with sources of trouble when we are designing, we must do as much as possible on the drafting board. We are not justified in cutting performance or developing crutches for overcoming difficulties unless we know that all has been done

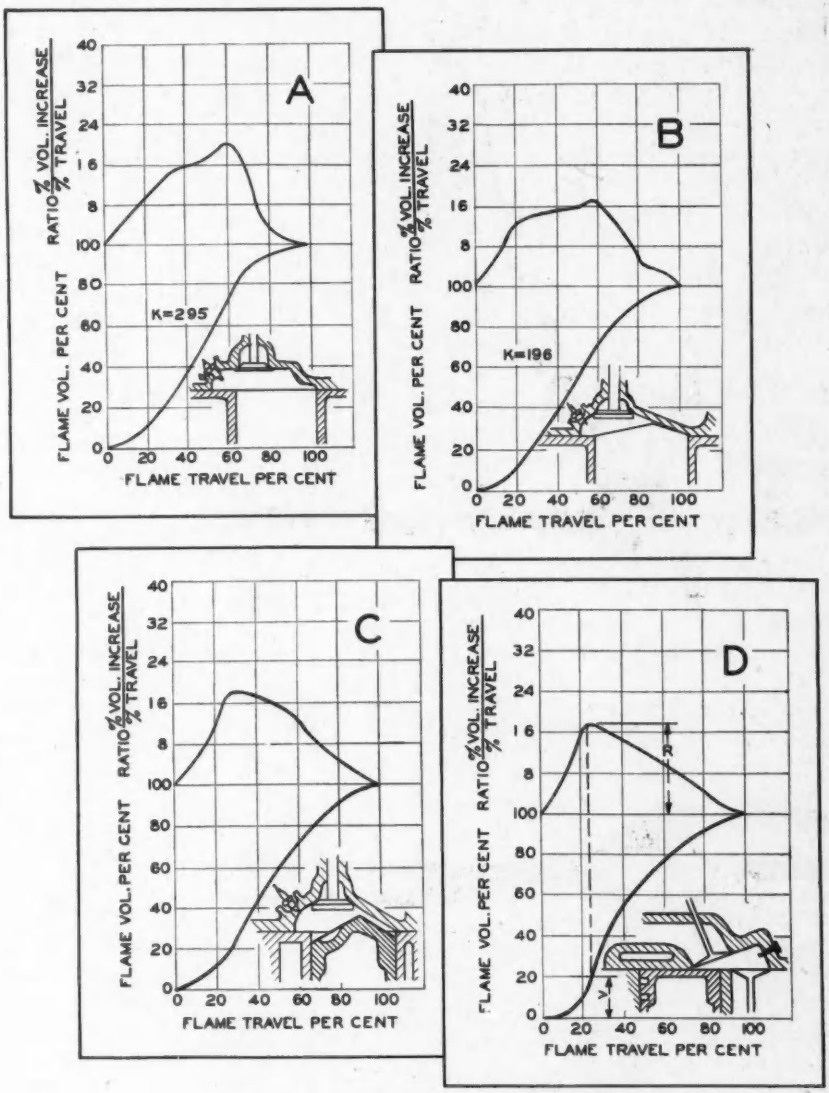


Fig. 4—Volume Distribution charts (A) for rough engine before change, (B) for an intermediate step, (C) for the second modification, (D) for an F-head engine which is very smooth.

through design (which does not affect the cost of the product). This calls for some degree of pre-determination, which can always be done safely provided we are armed with ample experience on the road, and that the method used, always with experience, produced a smooth engine when such is indicated. It is possible to develop theoretical thermodynamic data on the board from which indications affecting designs may be used. However it is possible to stop short of this complex work if we select factors that remain relatively proportional to what they would be if ground through the thermodynamic mill. Such a method permits the designer to see what he is doing and allows him to determine the reasoning as well as the shape of the chamber. Through the years objections have rumbled through learned halls, but never has a substitute been offered that could be used for predetermination. Practicing engineers must rely on those things that happen within the orbit of their individual experience. The best experience that we can offer is the following:

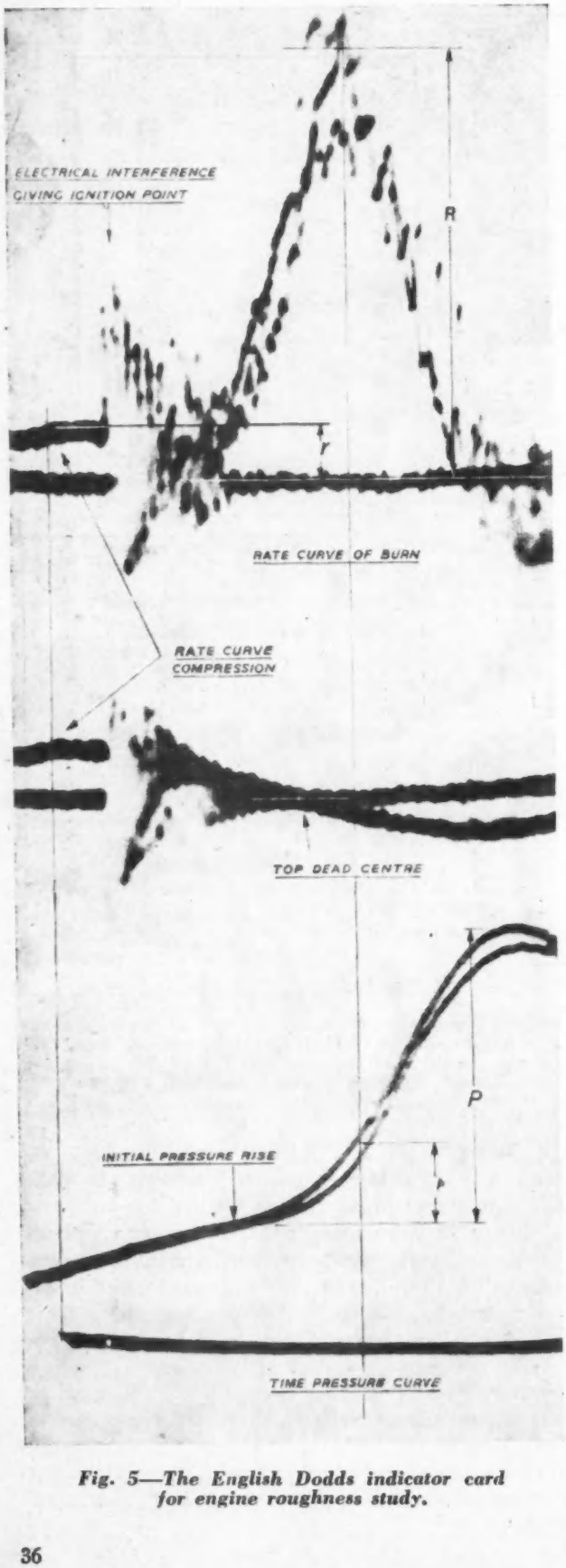


Fig. 5—The English Dodds indicator card for engine roughness study.

In England we had a 10 hp job in production that was a good performer but we were suffering from 10 per cent rejections for bump and roughness. It was decided to increase the bore a quarter of an inch and as expected the new job was decidedly uncommercial. Neither the original nor the new job had been treated for combustion roughness although the plaster cast indicated that the conditions would be bad. In order to understand the procedure of forecasting roughness by the plaster cast method, we refer the reader to the author's treatment of this process in the discussion of a paper given by C. C. Minter, SAE Transactions, Volume 30, April 1935, 159-162. Fig. 4 shows: A. This is the general design before change, and the volume distribution is the combination of the distance from spark plug in per cent of each flame front and the per cent of each volume. The upper curve is the ratio of this combination which symbolizes the rate at which mixture is available to be burned throughout the burning. The maximum rate is two and comes at the time 73 per cent of the volume has been burned. Hence, the ratio is reinforced by the resulting pressure. For design purposes and for comparisons we treat rate as velocity, therefore we represent this result as $\text{rate}^2 \times V = 2^2 \times 73$ which gives a roughness factor of 292. B. is an intermediate step wherein an effort was made to do two things at one time, increase the quench area and control the volume with a tapered chamber.

The plaster forecast for this chamber was encouraging but from previous experience we felt it was not good enough, so modification C. was made. This was an attempt to provide more volume at the beginning of burning and there was no opportunity within the chamber proper so it was accomplished by sinking an egg shaped depression in the piston. This resulted in a roughness factor of 78 and from our past experience should be good.

The engines built from this data were fine. In fact we were in the unique position that the engine with the small bore had ten per cent rejects for roughness and the larger bore engine on the same shaft had no rejects.

This has been our experience on plaster forecasting always; if the indications were smooth, then the engine was smooth. However, this was up to compression ratios of 7.25 to 1. As we go higher in compression ratios the need for care is important, but we will not get by unless supported by a decent crank-

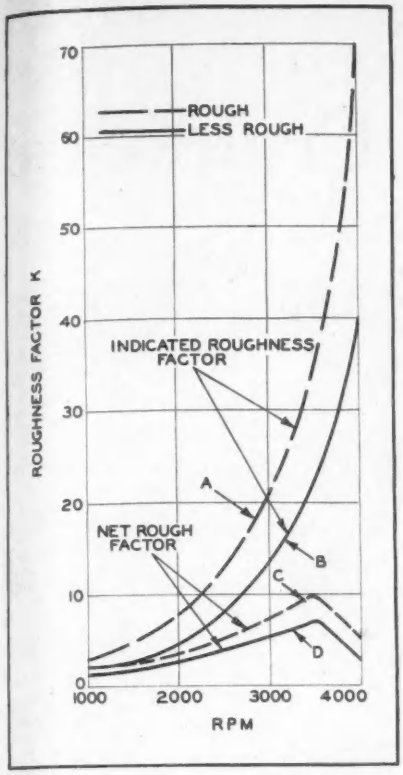


Fig. 6 — Calculated roughness factor with varying rpm and the roughness factor curve corrected for inertia forces.

shaft, crankcase, and other considerations, some still unknown.

Fig. 4D shows curves taken from F-head engine combustion chamber which is very good. This is characteristic of the breed since several chambers have indicated this same characteristic without correction.

An instrumentation program with finished engine, for engine roughness study, which proved most interesting was using the English Dodds indicator. The pressure element was of the water-cooled displacement type and the circuit could be switched at will from a normal indicator card to a rate of pressure rise card. Fig. 5 shows both cards.

The lower curve shows the max-pressure and the pressure at time of maximum rate. These can be calibrated into psi or can be used as a ratio. For comparison of cylinder head shapes and spark plug position the maximum rate of rise can be compared to the constant rate curve of compression. By comparing R to r and the position of R relative to the time pressure curve at bottom we can select the combination most likely to be smooth. A lower rate of pressure rise at a lower pressure will and has so far given the best results. There is a catch in this. This is not the net roughness picture, it is an indicated roughness only.

Curves such as these were made throughout the speed range, between two cylinder heads, one considered rough and one considered less rough. Plaster forecasts showed a difference of 300 to 200, neither would be smooth. The indicator cards such as shown in Fig. 5 were used. For lack of knowing better the roughness value was based upon: $\frac{R^2}{r} \times p$ At 1000 rpm the values were approximately 3 to 2, but they diverged and at 4000 rpm they were about 9 to 4. However the individual values had gone up to a force 30 times greater for the rough job and 20 times greater than the less rough job. The kinetic energy indicated was more than sufficient to smash up the engine, yet it did not, surely something was wrong and it could not be the engine. Then we woke up, or thought we did. We decided to recalculate the results, deducting the inertia force of the piston pin and rings at the time of maximum rate of pressure rise.

The rate curve went up with speed tremendously and the peak moved over to the right coming at a time of greater pressure, varying the offsetting inertia force, which increased as it arrived at top dead center. This calculation gave results as shown in Fig. 6. Curves *A* and *B* are the calculated indicated results and curves *C* and *D* were corrected for inertia forces.

These curves may be of little value. However, they do answer two questions: Why the engine does not blow up at high speed, and why some engines, particularly with iron pistons, smooth out for a while above 3500 rpm.

It is well to remember that the exciting forces which create the rip tide of vibration which seethes through the engine, such as, flywheel flutter, crankshaft beaming, torsional periods, crankcase transverse deflection, longitudinal crankcase web deflection, operate through the shaft end of the connecting rod. The dynamic out-of-balance of the crankshaft itself is another exciting force, but even this is mainly affected by the weight of the shaft ends of the rods.

Hence, it is understandable that some of the primary excitations will counteract each other, since the entire rotating assembly must be considered an elastic system. There are wheels within wheels that are separately active, forces within forces, each force

(*Turn to page* 80, *please*)

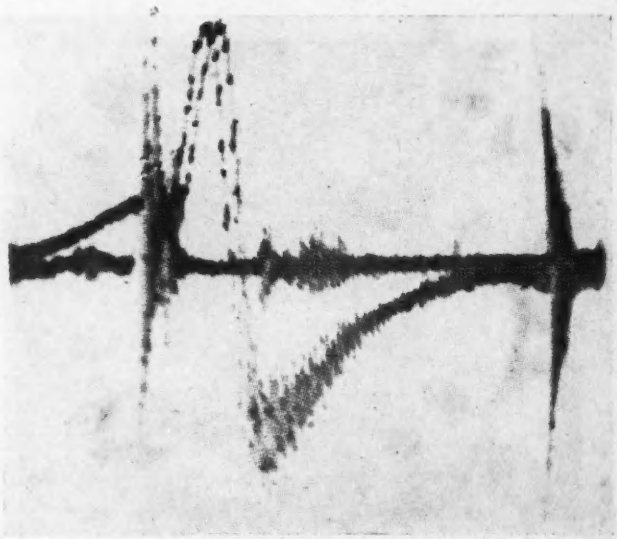
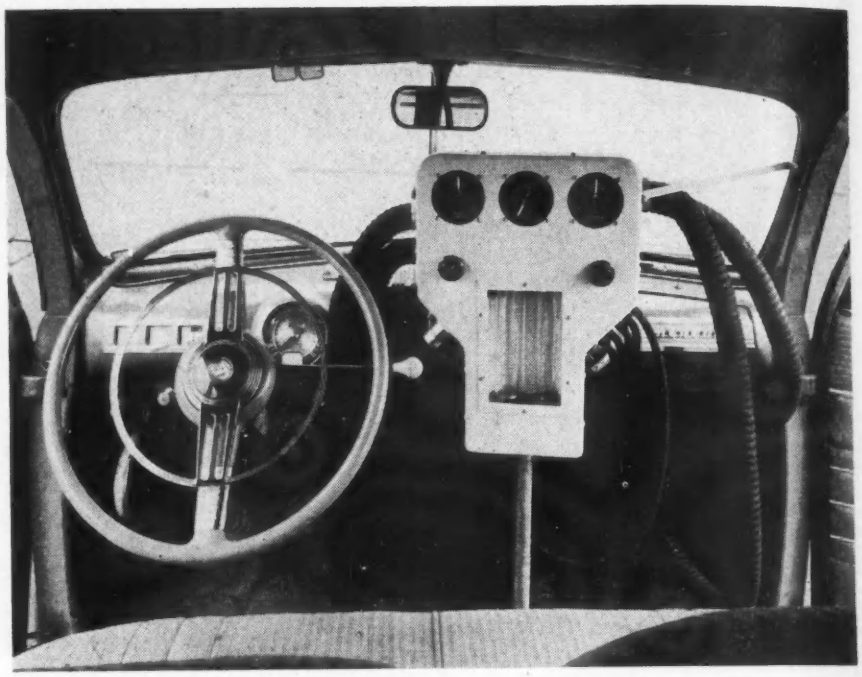


Fig. 7—A rate of pressure indicator card showing the disturbance characteristics of main pressure and detonation, the sudden rise at the right.

Flowmeter for Testing Crankcase



Flowmeter installation in a Mercury.

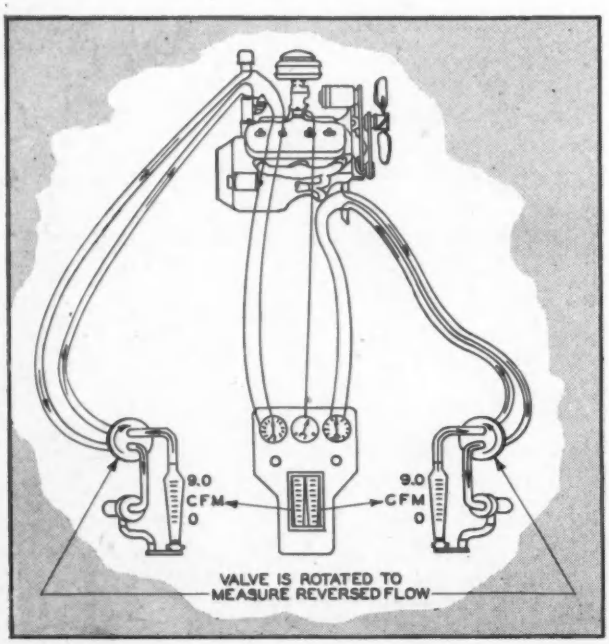
A NEW flowmeter has been developed by the Ford Motor Co. to eliminate the guess work in measuring the air flow through an engine for testing crankcase ventilation systems. The device is designed to be installed and used in an autobils under actual operating conditions. Instantaneous readings can be taken and are of far greater value than average readings taken over a period of time or distance.

The schematic drawing shows the principle of operation and construction of this flowmeter which in reality is two duplicate instruments built as one. The left instrument measures the flow of fresh air entering the engine and the right instrument measures the total outlet flow. To permit such measurement it is necessary to include the flowmeter in the normal ventilating system of the engine. This is accomplished by interrupting the system at the inlet and outlet openings and inserting the appropriate side of the instrument by means of flexible hose.

The added restriction of the hose and meter is compensated for by means of a built-in variable speed blower. In this manner it is possible to include the flowmeter in the system without disturbing or restricting the inlet and outlet openings since such factors as fan blast, car velocity, and body construction features influence certain types of ventilation systems.

The basic components of the flowmeter are the rotameters and the attached compensating blowers. The rotameter permits direct reading of air flow in cubic feet per minute and is graduated to enable reading from one-tenth to nine cfm. The electric motor-driven blower unit, controlled by a rheostat, is used to overcome the resistance of the meter and connecting engine lines. This resistance is indicated by a differential gage which has a range of −5 to 0 to +5 in. of water.

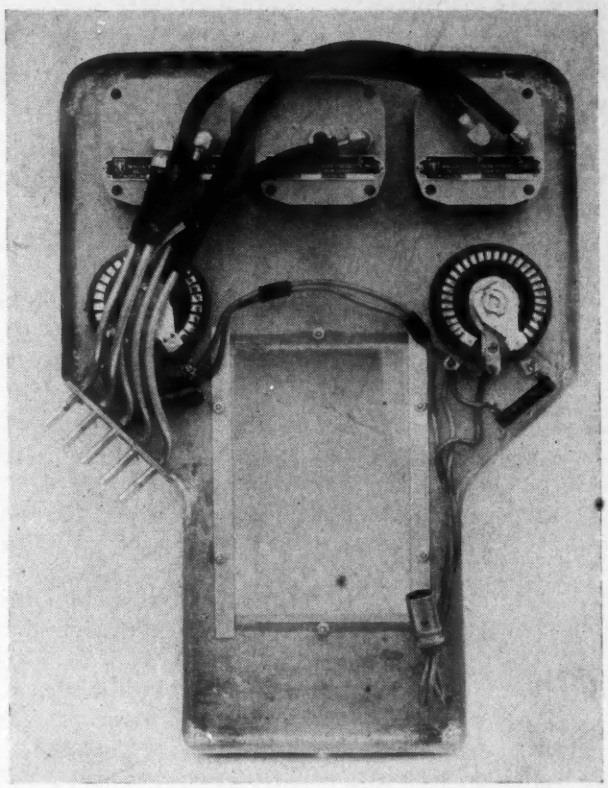
Each side of the flowmeter includes a two-way valve which permits reverse flow measurement. This is



Schematic diagram of flowmeter for measuring blow-by and crankcase ventilation.

Ventilation

By B. Gratz Brown,
Ford Automotive Research Department



Back of panel cover, showing differential pressure gage installation.

required to maintain the same direction of flow through the blower and rotameter. In addition to the differential water gages, a gage indicating manifold vacuum in inches of mercury is included for use under various test conditions.

When the flowmeter is used to measure ventilation, the inlet breather is disconnected from the engine and connected by flexible hose to the "in" connection of the left instrument. A second tube is then used to connect the "out" connection to the engine at the point where the breather was formerly connected. Thus air flowing into the engine enters at the breather, passes through the connecting tube into one side of the two-way valve, through the blower unit where compensating pressure for any line drop is built up, through the rotameter where the flow is indicated, and then returns to the engine through the other side of the two-way valve and connecting tube.

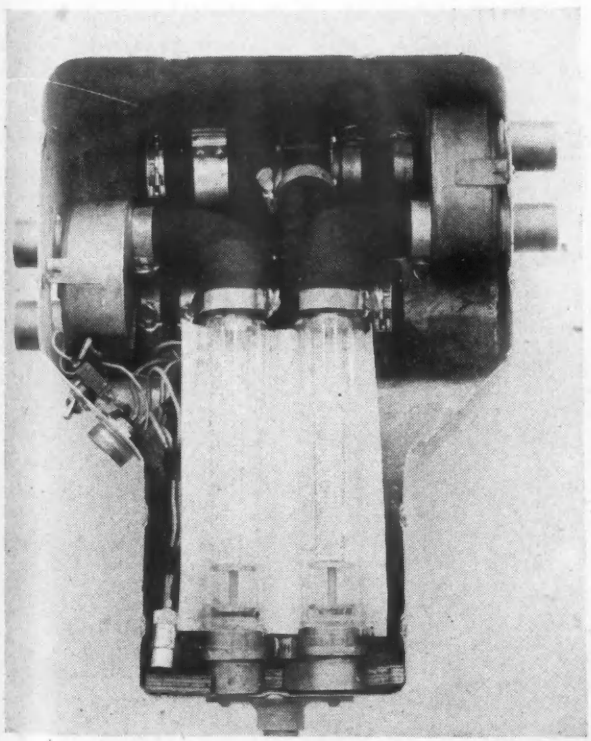
Pressure taps, located at each of the connecting points in the engine, are connected by tubing to the left differential gage. Thus when the blower maintains a differential pressure of zero between these two points, there is no added restriction and the ventilation system will function in its normal manner.

In the same way the engine outlet is interrupted and connected to the right side of the flowmeter with pressure taps at the break connected to the right differential gage. All other openings in the crankcase or engine, such as the oil level gage and vents in the fuel pump, must be plugged to permit all air entering and leaving the engine to pass through the flowmeter.

If the device is used to measure blow-by only, one instrument is sufficient. The inlet is connected to any one engine outlet and all other outlets are plugged. The outlet is left open to the atmosphere at a point where the gases will not be objectionable or the flow influenced by pressures induced during movement of the car. Pressure taps, located at the outlet connection of the engine and at the atmospheric end of the outlet tube, are connected to the differential gage.

Tests normally are run under both road load and full throttle conditions and readings taken at idle and in steps of 10 mph from 10 mph to top speed. Tests at low speeds also are made in second and third gear. The test procedure used for each step is to hold the speed and load constant by observing both the speedometer and the manifold vacuum gage. The blower rheostats are then adjusted until both differential gages have zero readings. When this has been

(*Turn to page* 66, *please*)



Inside of meter panel, showing the rotameters connected to flexible hose.

Design Trend of

THE problem posed by the metallurgical shortcomings of available materials for exhaust system fabrication must be conquered before any extensive progress can be made in future exhaust equipment. The advent of commercial and military aircraft operation accompanied by a swift increase in power ratings and improvement in aircraft performance necessitated exhaust system design improvements and forced a greater utilization of exhaust gas energy. These developments were the atmospheric discharge type exhaust collector, the development of exhaust driven turbosupercharger installations and the use of ejector stacks. The fabrication of the simple atmospheric discharge exhaust collector was marked by improvements in the mechanical design of the collector and heat muff for cabin air together with the development of intensifier tubes and boilers for increased safety in cabin heating.

The exhaust driven turbosupercharger installations brought increased high altitude performance through the use of exhaust energy in driving the turbine. Design improvements were necessitated by this type of installation because of the rigid conditions involved requiring an exhaust collector which would provide minimum leakage characteristics while being subjected to increased operating temperatures and greatly increased internal pressures.

The use of ejector stacks was initiated at this time primarily for military aircraft. Ryan has produced ejector stacks which have added as much as 28 mph to a plane's top speed. This type of exhaust system has been used rather extensively for low and medium altitude operations. Many mechanical design problems have been and are being encountered with this installation due to the destructive action of the jet thrust forces on the exhaust stacks.

In the matter of the exhaust collector versus the ejector stack, tests have brought out the fact that jet stacks have a prohibitive noise level that precludes their extensive use in commercial airline operation due to the demands of passenger comfort. Available sound proofing materials have failed to reduce the noise level to the comfort range when this type of exhaust system is used.

To date, the service life of jet stacks has been very low compared to that of collector rings. Mechanical design changes, involving increased weight, will undoubtedly add to jet stack longevity. In order to obtain the greatest jet thrust from ejector stacks, they should discharge the exhaust as quickly as possible through relatively straight pipes. To accomplish this they must be arranged around the periphery of the engine nacelle. Discharging gases in this manner detracts from passenger comfort, not only because of the high noise level, but also due to the resultant flame glare visible during night flights. This discomfort, especially vivid for the inexperienced air travelers, will be important enough to prohibit the use of this type of stack installation on commercial transports. The flame glare can be hidden from the passenger's views by means of shields which add weight and drag to the airplane. It is also possible to eliminate the glare by discharging the gases on the outboard side of the nacelles, out of passenger view, but this practice greatly increases the stresses to which the jet stacks are subjected because of overhang. Service life suffers as a result.

The use of properly designed jet stacks will increase the speed of an airplane. In the future this advantage will be realized by light military aircraft, using reciprocating engines without exhaust turbines, in which speed is of greater importance than comfort and service life. Military cargo aircraft may be included in this category. Transport aircraft, high altitude planes with exhaust turbine installations and

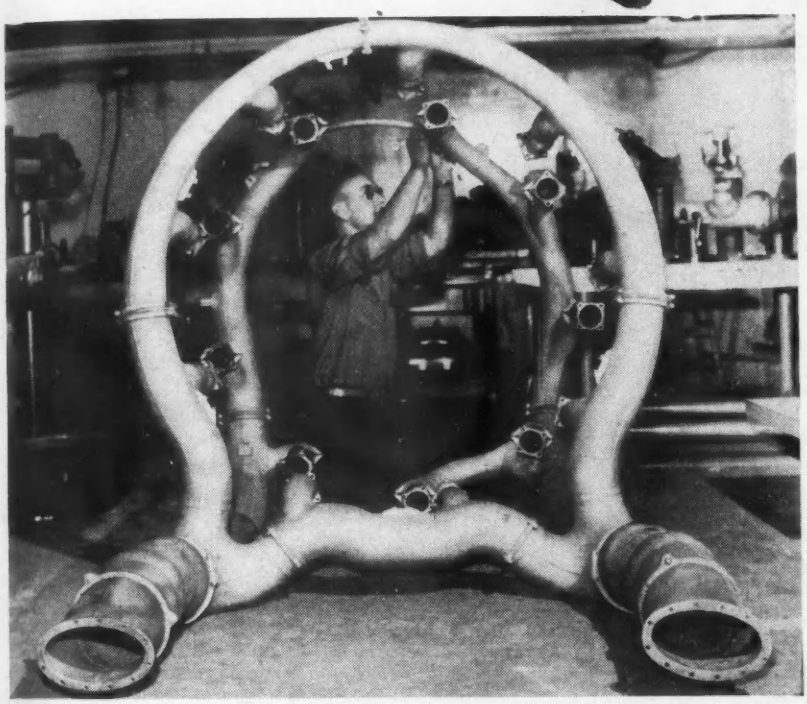
Craftsmen check dimensions and carefully align exhaust manifolds to fit precision aviation engines.

Aircraft Exhaust Systems

By *Ralph L. Haver*
Chief Engineer

and *Harry A. Goodin, Jr.*
Asst. Chief Engineer,
Metal Products Division,
Ryan Aeronautical Co.

(Above) Ryan ball and socket joint which permits flexible and remote mounting of exhaust system.



Octopus-like exhaust manifold built by Ryan for an 18-cylinder aircraft engine.

(Below) Heat exchanger for transferring heat from exhaust gases to air circulating through the airplane.

commercial cargo craft with reciprocating power plants will use the exhaust collector ring.

One of the most important questions concerning the operator of aircraft is that of service life. The service life of present day exhaust system equipment is considerably better than that obtained 10 or 12 years ago, but it is not better, on the average, than that experienced immediately prior to World War II. This is not due to reduced quality of design, materials or workmanship during the war, but is largely attributable to the rapid increase in horsepower rating of aircraft engines which has not kept pace with design and metallurgical advances in exhaust equipment. There are many problems involved in the immediate correction of this trend. Because of increased engine power ratings, exhaust systems must be larger to accommodate the flow of exhaust gases without excessive back pressures at the exhaust ports. This reduces the rigidity of the collector and increases the weight. The inertia loading is also increased. These factors tend to shorten appreciably the service life expectancy.

(Next page, please)

Reduced cross-sectional area factors have been employed as engine manufacturers have increased allowable back pressures but this results in increased operating temperatures and consequent reductions in the allowable design stresses. The reduction in area factor also increases thrust loads and internal pressures which increase the working stresses in the metal.

An increase in service life of exhaust equipment is dictated by the need for improved safety and reliability as well as economy of maintenance. If global air transport is to come into its own, mechanical design refinements must alleviate this need.

The trend of exhaust system design during the war was toward the complicated structure. Designs of the future, with improved service life, will require simplification, removal of gadgets and addition of means for absorbing stresses simply and directly. Ryan engineers are convinced that further progress can be made by giving consideration to the exhaust equipment at the conception of the power plant design. Exhaust systems that are to give satisfactory life must be designed for the functions they are to accomplish rather than to fit into the available space after the remainder of the power plant has been designed.

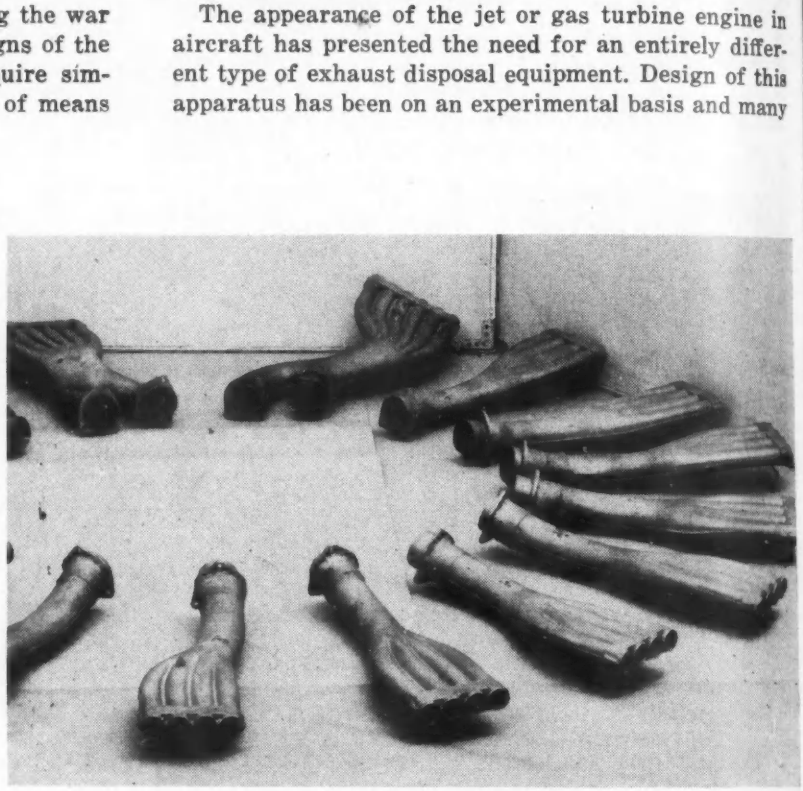
There is a definite trend in design which will require a basic change in exhaust structure to the effect that the system be supported by other means than the exhaust port pad and exhaust collector port legs. This is necessitated by the increase in the ratio of horsepower output to cubic inch displacement of the engine. To accomplish this result, increased cylinder head finning in order to cool valve seats and guides is mandatory. In turn, the exhaust port pad area has been reduced and head temperatures raised to the point that there is not sufficient room nor strength to support the exhaust system in the conventional manner.

This means that the exhaust system must be supported by rocker box pads which will be designed for this purpose or supported by the airframe structure and connected to the engine by means of flexible joints which will accomodate the engine movement. Joints of this type have been developed in the last few years and have been successfully applied to a number of installations. The Ryan ball and socket type joint is the one used most extensively for this purpose.

The fact that sizeable quantities of energy are discharged to the atmosphere by means of exhaust gases has been a challenge to designers to find means of harnessing it. This energy has been made to serve as a source of cabin heat carburetor air heat, exhaust turbine power and jet thrust. It has been utilized for surface anti-icing, gun turret heating and is being employed in propeller anti-icing experiments.

The development of the augmentor or aspirator has provided greater usefulness for exhaust gas energy. This innovation, which is employed in the forward engine of the Ryan FR-1 Fireball, utilizes the energy in the exhaust through a jet pump to facilitate removal of cooling air from the engine compartment. Expansion of this use will permit the elimination of flaps or fixed gill openings and will reduce the cooling horsepower required. Refinements of this principle will require variable discharge nozzles in the exhaust system at the augmentor inlet which will be designed to control the pressures in the exhaust system in order to gain maximum efficiency.

The appearance of the jet or gas turbine engine in aircraft has presented the need for an entirely different type of exhaust disposal equipment. Design of this apparatus has been on an experimental basis and many problems have been encountered. The exhaust system now becomes the major source of power for flying the airplane by means of thrust from the exhaust gas jet. The exhaust system, as well as the turbine bucket wheel, must absorb this jet thrust and transmit it to the airframe. Of necessity this type of exhaust tailpipe is large in diameter. Its rigidity is very low compared to collector ring bodies and it must be reinforced by means of external stiffeners. It is mounted in a manner that will accomodate large expansions, especially along the axis of the pipe, while absorbing thrust forces.



Jet propulsion exhaust stacks which increase exhaust velocity and develop added reactive thrust.

Since the exhaust gases must be picked up by the exhaust system at the turbine wheel, a fairing must be provided and suspended inside the exhaust pipe in order to maintain a smooth flow of exhaust gases as well as to prevent the hub of the turbine wheel from overheating. It is this inner fairing that must absorb a large part of the thrust from the column of

(*Turn to page* 92, *please*)

Observations

by Joseph Geschelin

New Vista In Plastics

It is too bad that before the war plastics and rubber compounds were classified simply as chemical products and lumped together in research laboratories. The fact is that each one offers a complexity of problems and each one deserves separate treatment by specialists. There have been some classic failures of plastics in motor cars and these have been charged to "plastics" with the result that the same producers may be soured on the use of a plastic. Actually, for any practical application there is some unique formulation that will do the job acceptably. We have learned recently of some plastics, not yet generally in commercial use, which have properties similar to the useful metals. They resist the attack of chemicals and high temperatures. They will be useful in certain applications where an exceptional kind of gasket material is required, just to cite one example. The point is that broad-brush methods of selection no longer will do.

Gasoline Injection

Since we commented on gasoline injection systems some time ago, we find at least three manufacturers, and possibly four, engaged in the development of such equipment for use in motor vehicles. Some of the earlier discussion was quite premature because all of the manufacturers started with systems designed specifically for aircraft. No one had a system suited exactly for engines used in motor trucks and buses. Even at this writing motor vehicle applications are experimental and have not yet borne fruit. Besides adapting aircraft injection systems to the need of road vehicles, the producers are faced with the major problem of cutting corners to reduce cost to the levels acceptable in the motor vehicle field.

Hydraulic Steering

At the present writing cost is the only bar to the adoption of hydraulic power steering in heavy-duty vehicles. Power steering no longer is new or untried. Thousands of units were produced for heavy military vehicles during the war. Right now at least one truck builder and one of the largest tractor producers are using power steering on certain models. What is needed is some volume production to justify the kind of tooling that will get costs down to a reasonable commercial level. You will recall that recently Bendix announced its hydraulic power steering unit. This will be embodied in the product of two of the leading producers of heavy-duty steering gear. One is already producing in small lots, the other will be ready for mass production at the proper time.

War Time Packaging

The art of packaging automotive parts rose to a high plane during the war what with the need for protection against mechanical damage, water, corrosion, etc., in making shipments to bases all over the world. Although the practice was imperative so far as the Army and Navy were concerned, its cost was extremely high. We know of some cases where packaging cost several times the value of the product itself. Now that industry has gained the know-how and now that various types of materials and plastic compounds are commercially available, the question is: how much of the technique is required for normal peace-time shipment and storage. Producers of the packaging materials can do a constructive job by developing simple procedures more nearly suited to the normal problems of the industry and at a cost that can be justified by the results.

Better Paint Better Quality

The stress and strain of war made it almost impossible to maintain the high standards of plant housekeeping to which we had become accustomed. We have visited some of the leading plants in recent months only to find that some of the bright painted interiors—so prevalent in our industry—are now drab and unattractive. We know this will be corrected just as quickly as labor and materials are more plentiful. For in this industry it has been recognized that good housekeeping and quality go hand in hand. When plant housekeeping is again given special attention, don't overlook the value of painting machine tools in color—for identification, for improved quality, for better seeing and for improved safety of operation.

On Curved Glass

Since our last report on curved windshield glass, the leading producers of glass tell us they are prepared to meet the demand of the industry right now. Whether many motor car producers will make enough changes for '47 to constitute a heavy demand for curved glass is another matter. On the other hand, curved glass is probably in the bag for '48.

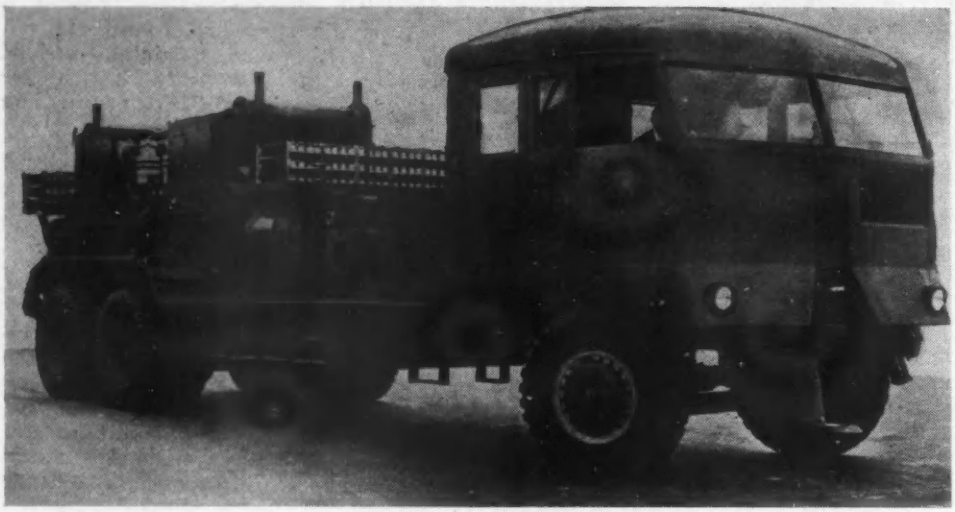
Scientific Stress Analysis

The article on stress analysis as it is used by Trailmobile for the study of trailer bodies and running gear which appeared in AAI, October 15, 1946 turned out to be quite timely. That such methods appear to be a must in the design of lighter weight but stronger autobodies in the future was a prediction made by W. K. Norwick of Fisher Body at the recent meeting of the American Society of Body Engineers. There is a considerable body of experience in the use of strain gages, Stresscoat, and other techniques which could be adopted and refined for use in studying autobody design.

Independent Suspensions

We had a visitor the other day who demonstrated a small scale model of a passenger car chassis featuring a unique suspension system for all four wheels. Basic suspension element in the air spring—either one or two units at each end. They use parallel swinging arms front and rear, in combination with long longitudinal radius arms for each wheel. The rear axle differential is frame-mounted and uses swinging axles with universal joint connections. They claim the design has been road tested and yields an excellent ride under extremes of road surfaces and speeds. This job is to be presented to certain car companies in the near future.

1000 Hp, 45 Mph Truck Dynamometer



A 60-TON, 1000 hp, 45 mph combination truck-dynamometer, built through the co-operative efforts of the General Electric Co., the Knuckey Truck Co., and the U. S. Army Ordnance Department, will soon be in service at the Aberdeen Proving Ground, Maryland. Primary purpose of the 40-ft, gasoline-electric dynamometer is to test the tractive effort of large Army wheeled and tracked combat vehicles over various types of terrain. As such, it rates a maximum drawbar pull of 60,000 lb at speed as low as two mph.

Employed as a prime mover to tow test equipment, such as heavy field pieces and trailers, to ascertain tractive rolling resistance, the truck rates continuously 38,000 lb tractive effort at a speed of 2.5 mph. As a truck functioning merely to propel itself, the vehicle is capable of 60,000 lb tractive effort and a top speed of 45 mph.

The 1000-hp drive is provided by two 500 hp, engine-generator power plants, each consisting of a Ford tank engine and a General Electric traction generator. Each generator supplies power to two traction motors which drive the wheels through sprocket and chain drive. The dynamometer can be operated with one or both power plants and its operational performance is recorded by draw bar strain gage equipment and elaborate speed, time, and fuel consumption instruments.

Evans Postwar Auto-Railers

POSTWAR Auto-Railers produced by the Evans Products Co. of Detroit, Mich., will have standard 130 in. wheelbase International chassis. Most important of the new features is a simplified hydraulically-operated retraction mechanism for the flanged pilot wheels. Operation is from a fan belt driven pump and is controlled by a selector valve with double two-way spring return with an integral relief valve. Pilot wheels can be lowered or raised by pushing or pulling the pilot axle control on the instrument panel. During rail operation about 50 per cent of the vehicle load is carried by the tires. Tread is U. S. standard track gage.

GVW is 6150 lb and the payload capacity is 1640 lb with the panel body or 1000 lb with the inspection car body, which is shown in the accompanying photograph. The six-cylinder engine has a maximum rating of 82.4 bhp at 3400 rpm and maximum torque of 160 lb-ft at 1200 rpm. Speeds up to 60 mph are claimed for both railroad track and highway operation.

1946 *Registrations* Up 2,854,000 *Over 1945*

Truck Registrations Highest in History — Passenger Car Total Surpassed Only by 1941

By Marcus Ainsworth

TRUCK registrations as of the end of 1946 will have reached an all time peak of about 5,600,000, passing the previous peak year of 1941 by approximately 700,000. Passenger car registrations will be approximately 2,100,000 greater than 1945 and will be the largest in history with the exception of the peak year 1941 when 29,240,475 cars were registered.

These registration statistics result from the annual survey conducted by AUTOMOTIVE AND AVIATION INDUSTRIES for the purpose of forecasting total motor vehicle registrations during the year 1946. Forty-one states and the District of Columbia have cooperated with us, furnishing their latest available data (which in most cases was that of September 30) and in addition have given us their estimate for the remainder of their calendar or their fiscal year. Past experience with the data obtained in this annual survey, which has been conducted for many years, indicates that the estimated totals are usually within one per cent or less of the final returns. Unfortunately this year it is rather difficult to furnish estimates due to the uncertainty of the number of new cars, trucks and busses that will be produced and enter into private and commercial use.

However, it is estimated on the basis of the returns received this year that the number of motor vehicles registered throughout the United States during the year 1946 will be about 33,233,975 as compared with 30,379,786 for 1945, an increase of 2,854,189 cars, trucks and buses combined or 9.6 per cent. These

(*Turn to page* 88, *please*)

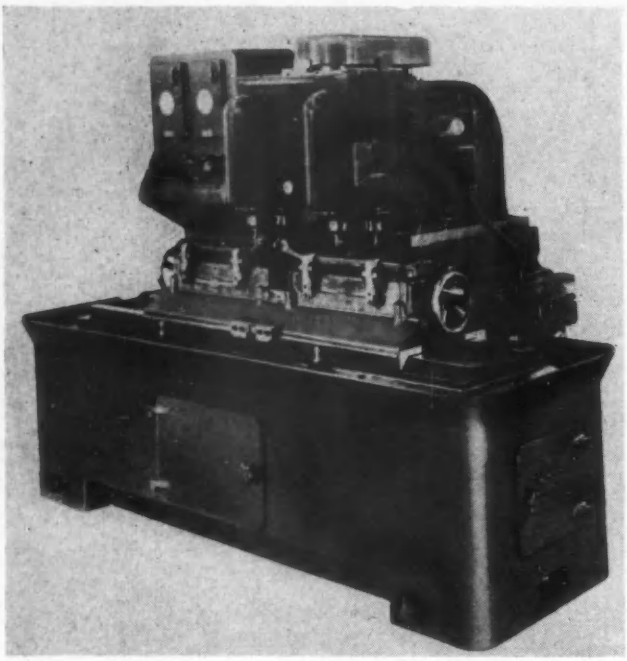
Forecast of 1946 Motor Vehicle Registrations

State	Passenger Cars[1]		Trucks		Buses		Total Motor Vehicles		Per Cent Increase
	1946	1945	1946	1945	1946	1945	1946	1945	
Alabama	296,604	278,493	86,441	72,141	1,823	1,955	384,868	352,589	9.0
Arizona	118,165	112,855	29,400	29,462	520[1]	700[1]	148,085	143,017	3.4
Arkansas	222,000	193,875	110,617	78,902	1,500	1,103	334,117	273,880	22.1
California	2,469,790	2,238,613	387,244	355,282	6,290	6,033	2,863,324[4]	2,599,928[4]	10.2
Colorado	299,350	269,616	89,200	76,837	[2]	[2]	388,550	346,453	12.1
Connecticut	430,661	409,710	65,094	58,861	2,267	1,384	498,022	469,935	6.0
Delaware	56,000	53,610	14,500	13,162	[2]	[2]	70,500	66,772	5.8
Dist. of Columbia	102,294	96,087	13,818	13,879	2,100	2,132	118,212	112,098	5.3
Florida	470,000	423,158	116,000	96,384	3,800	3,211	589,800	522,753	12.8
Georgia	443,214	419,290	124,222	104,650	4,715	4,768	572,151	528,708	8.2
Idaho	120,000	111,770	43,000	38,352	250	206	163,250	150,328	8.6
Illinois	1,680,000	1,506,222	262,000	224,929	[2]	[2]	1,942,000	1,733,151	12.1
Indiana	852,500	833,908	176,800	137,809	7,464	7,330	1,036,764	979,047	6.0
Iowa	626,828	588,295	118,787	102,176	[2]	[2]	745,615	690,471	8.0
Kansas	512,680	476,596	140,237	129,353	[2]	[2]	652,917	605,949	8.0
Kentucky	370,000	351,825	94,000	82,017	.....	.....	464,000	433,842	7.0
Louisiana	317,200	322,749	93,600	78,256	3,300	3,248	414,100	404,253	2.3
Maine	168,125	153,861	55,000	49,891	450	493	223,575	204,245	9.5
Maryland	422,564	379,220	75,395	65,090	1,800	1,218	499,759	445,528	12.1
Massachusetts	832,500	744,364	130,000	111,417	5,780	5,471	68,280	861,252	12.3
Michigan	1,371,055	1,307,475	146,526	123,406	[2]	[2]	1,517,581	1,430,881	5.9
Minnesota	667,000	632,659	130,000	115,906	410	375	797,410	748,940	6.6
Mississippi	195,000	184,321	77,500	68,988	3,000	2,707	275,500	256,016	7.3
Missouri	760,000	697,168	174,000	157,084	.....	.....	934,000	854,252	9.2
Montana	119,800	108,625	53,300	48,260	[2]	[2]	173,100	156,885	10.3
Nebraska	338,000	331,076	82,000	75,554	675	582	418,675	407,212	2.9
Nevada	38,717	35,583	10,778	9,193	[2]	[2]	49,495	44,776	10.7
New Hampshire	106,500	95,113	36,200	23,483	[2]	[2]	142,700	118,596	20.4
New Jersey	936,055	860,000	164,820	149,000	10,474[1]	8,800	1,111,349	1,017,800	9.5
New Mexico	95,000	86,823	33,000	29,640	.....	1,522	128,000	117,985	8.8
New York	2,200,000	1,983,693	384,000	354,052	35,000	31,486[1]	2,619,000	2,369,231	10.5
North Carolina	550,715	502,700	129,162	97,500	8,000	2,850	687,877	603,050	14.0
North Dakota	139,427	131,468	53,958	49,262	164	160	193,549	180,890	7.0
Ohio	1,766,000	1,684,390	228,000	196,810	3,400	2,995	1,997,400	1,884,195	6.0
Oklahoma	420,000	391,085	125,000	109,896	4,500[1]	4,501[1]	549,500	505,482	8.9
Oregon	360,000	330,771	98,881	82,408	1,545	1,218	460,426	414,397	11.1
Pennsylvania	1,865,784	1,731,430	337,699	304,972	10,162	8,993	2,213,645	2,045,395	8.1
Rhode Island	164,300	156,490	26,500	22,607	695	715	191,495	179,812	6.7
South Carolina	295,000	275,410	63,700	48,047	2,750	2,134	361,450	325,591	11.0
South Dakota	148,000	141,065	41,300	37,149	240	202	189,540	178,416	6.1
Tennessee	421,200	368,568	92,000	77,134	[3]	[3]	513,200	445,702	15.1
Texas	1,440,000	1,273,759	365,000	307,455	2,200	1,988	1,807,200	1,583,202	14.0
Utah	137,268	126,740	30,420	26,748	338	242	168,026	153,730	9.4
Vermont	86,000	80,666	13,200	11,667	168	157	99,368	92,490	7.3
Virginia	500,800	443,239	118,000	94,286	2,500	2,668	621,300	540,193	15.0
Washington	520,000	509,140	117,000	103,762	2,500	2,203	639,500	615,105	4.0
West Virginia	240,000	208,035	65,000	55,512	1,500	1,039	306,500	264,586	16.0
Wisconsin	740,000	692,575	154,450	142,240	1,850	1,886	896,300	836,701	7.0
Wyoming	66,000	62,640	27,000	21,436	.....	.....	93,000	84,076	10.5
Total	27,496,096	25,398,824	5,603,749	4,862,307	134,130	118,655	33,233,975	30,379,786	9.6

[1] Includes taxicabs.
[2] Included with trucks.
[3] Included with passenger cars.
[4] Does not include 128,415 vehicles originally registered in other states during 1945 and 130,000 in 1946.

Engineering Library

New Production and Plant Equipment



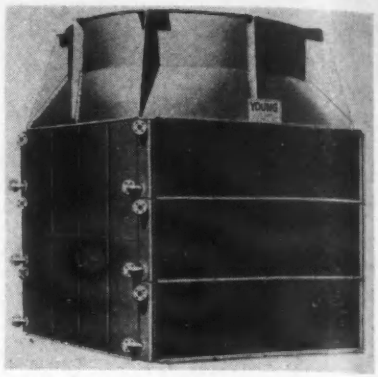
Two-stage milling machine made by Hydraulic Machinery, Inc.

A SPECIAL PURPOSE two-stage machine for milling the bosses or cylinder head castings, has been completed by Hydraulic Machinery, Inc., 12825 Ford Road, Dearborn, Mich. The machine is hydraulically operated and electrically controlled. Cycle of operation is as follows: (1) Operator unloads and loads part in station away from work position (2) while this is being done, milling head moves in, machining part, at work station (3) milling head retracts (4) the part which has just been loaded moves into work station (5) repeat. Production is 90 per hour at 80 per cent. Dimensions: 48 in. wide by 60 in. high by 72 in. long.

A SERIES of new type large capacity cooling and condensing radiators designated as VAD units has been announced by the Young Radiator Co., Racine, Wis.

The series ranges from the VAD-10, illustrated, to the larger VAD-16 with capacities for the water cooling unit ranging upward from 3,600,000 Btu/hr at standard conditions. The cooling faces are located on two opposite sides of the unit to permit line installation of several units where very large capacities are required, with no loss in efficiency or cooling faces blanketed off. Units are available for water cooling, oil cooling, steam and vapor condensing, gas cooling or in combination arrangements to handle two or more types of service.

Following are some of the developments incorporated into the VAD units: Vertical air discharge with an induced draft fan to obtain more even air distribution and eliminate recirculation and cross wind effects; low speed fan for high efficiency operation with minimum horsepower costs; coils mounted in a vertical plane for economical installation, easy maintenance and maximum protection from the elements; simplified manifolding to supply and return lines; tube and fin coils with heavy wall round tubes; removable end plates on water coils.



Young cooling and condensing radiator

A DOUBLE-END precision boring machine for rough and finish boring, counterboring, finish facing and chamfering three bearing holes in a gear case and mating gear cover, was recently built by the W. K. Millholland Machinery Co., Indianapolis, Ind., using standard Millholland cam-operated automatic units.

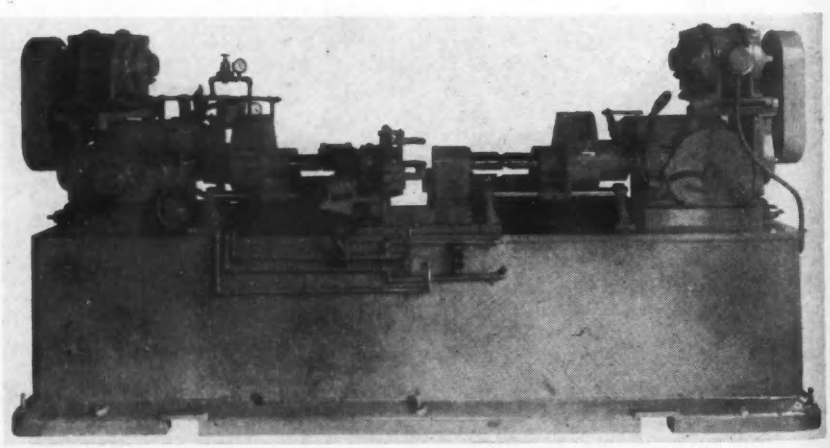
The work is clamped in an air operated fixture and the cycle is initiated by depressing a pushbutton which starts the automatic cycle for the roughing operation. As the roughing head returns to its starting position, it actuates a limit switch which in turn starts the cycle for the automatic finishing operation.

For the rough boring operation, the feed starts with a coarse feed and automatically changes to fine feed for counterboring and with a dwell for finishing up the facing.

For the finishing operation, the feed is automatically changed from finish boring to a fine feed for finish facing and with a dwell to finish face the bosses to close limits.

The profile of the cams on the units determine the rate of feed as the cam rollers are kept tight against the hardened steel cams at all times by means

(*Turn to page 72, please*)



Millholland double-end boring machine

How You Can Get More Freight Cars

With today's railroad freight car shortage continuing, it is imperative that we all again review our use of cars and determine what we can do to speed up the movement of freight.

Doing everything they can, American railroads have been unable to meet the demands. Actually, average miles traveled per car per day dropped from 51 in the second quarter of 1945 to 38.6 in the same quarter of 1946.

The railroads are making a serious effort to speed up switching and hauling time. We, the shippers and receivers, can also help by speeding up loading and unloading of cars . . . reduce waiting time at our sidings. If your plant is operating on a five day week, why not do your freight car loading and unloading on a six day basis and release those cars one day early.

If the average time of handling a car can be reduced a single day, the additional freight that can be hauled will be the equivalent of 100,000 extra railroad freight cars. You can also make your freight cars do *more* if you will ship *full carload* instead of *partial car loads.*

For example, in accordance with the Office of Defense Transportation's request we have succeeded in increasing the load in each car by 20% with a consequent 20% reduction in car requirements. As a supplier to the railroads and car building industry, we are furnishing our share of steel for new car construction, though we realize full well that it is not enough.

American manufacturers proved conclusively during the war that we can work in close cooperation. Today, we face another critical period when this same cooperation is needed. Let's all work with the railroads to keep cars moving; reap the benefits of extra shipping space, and speed up our national economy.

INLAND STEEL CO.

38 South Dearborn Street, Chicago 3, Illinois. Sales Offices: Detroit, Indianapolis, Kansas City, Milwaukee, New York, St. Louis, St. Paul

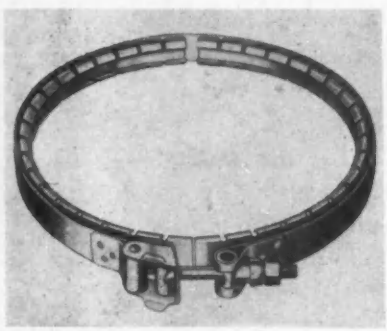
PRINCIPAL PRODUCTS: BARS • STRUCTURALS • PLATES • SHEETS • STRIP • RAILS
FLOOR PLATE • PILING • REINFORCING BARS • TIN PLATE • TRACK ACCESSORIES

Help! Help! Overcome the steel shortage by returning your scrap at once.

New Products for Aircraft

Manifold Coupling for High Temperature Conditions

Marmon Products Co., Inc., 940 Redono Blvd., Inglewood, Calif., has brought out a high-temperature manifold coupling which is said to afford a positive seal for all types of manifold joints operating under conditions



Marmon manifold coupling

of high temperature and excessive vibration.

Wedging action of the retainer ring draws together the flanges of the manifold joint as the coupling is tightened. High axial component of the clamp band tension that is transmitted into wedging action provides a positive seal.

One of the design features of the new coupling is the vented construction of its retainer ring which makes it possible for the coupling to remain at one-half the temperature of the manifold, giving an increasingly positive seal as the temperature of the manifold rises.

Linear Actuator for Many Applications

An electric-motor-operated linear actuator of the same dimensions as a hydraulic jack of an equal operating capacity is now being produced by Electrical Engineering and Mfg. Corp., 4606 W. Jefferson Blvd., Los Angeles, Calif.

Linear actuator made by Electrical Engineering and Mfg. Corp.

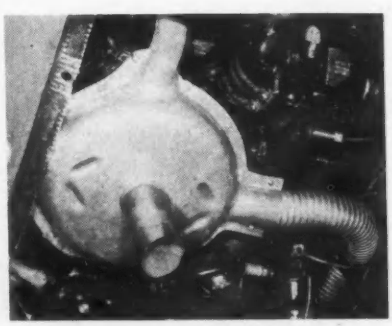
Though this unit was designed especially for wing flap operation, its development opens up possibilities for application on not only aircraft but other types of equipment as well. The same type of unit can be used wherever a hydraulic jack ordinarily is used.

The motor and entire mechanism of this actuator form a completely self-tained unit of simple, compact design, with the only outside elements being three connecting wires. It weighs 11 lb, 10 oz.

Designed for an average operating load of 3500 lb tension and compression, the actuator withstands a static load of 8000 lb tension and 12,750 lb compression, with an ultimate load of 25,000 lb compression. Jack speed at average load is ¼ in. per sec; length of travel, 4 in., with longer stroke if desired. Motor, 28-volt, d-c, 31 amp, intermittent duty type. Output at average load, ½ hp.

Muffler for Light Planes

Ryan Aeronautical Co., San Diego 1, Calif., has developed a muffler for light planes that is said to eliminate 90 per cent of the noise of the engine exhaust. The Ryan muffler works on the basic principle of slowing the velocity of the



Ryan muffler

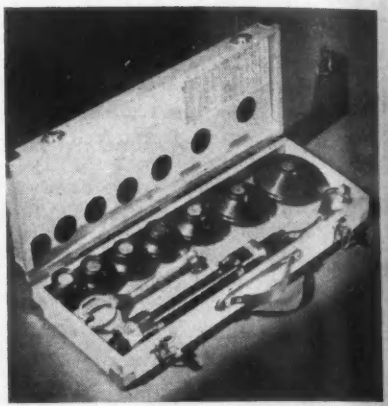
hot escaping gases by channeling them into an expansion chamber before their release into the open air.

The reduction in velocity of exhaust gases in the muffler's expansion chamber decreases the loudness of their "pop" as they expand into the air. Frequently this causes a back pressure which produces loss of power and engine overheating. In the Ryan muffler, however, engine power is said to be maintained since there is less than a two per cent power loss from back pressure.

Propeller Balancer

All types of propellers ranging from SAE 7.5 to SAE 60 in shaft size may be balanced with the Sutton balancer made by the Sutton Manufacturing Co., Third National Bldg., Dayton 2, Ohio.

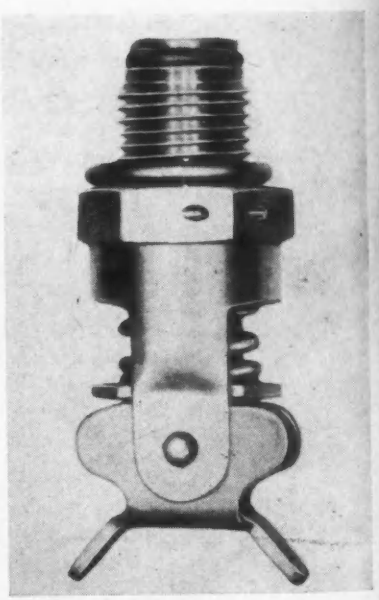
The balancer consists of a hollow shaft at the center of which is supported a cable. The propeller with the



Sutton balancer

balancer shaft and proper cone adapters attached is hung in a horizontal position from any convenient support. At the top of the balancer shaft is a disk which is fastened to the cable but is free floating over the vertical center line of the shaft. Under the disk is a ring which should be concentric with the disk when the propeller is in balance. Any portion of the ring which extends beyond the disk indicates that the propeller is heavy in the direction where the ring shows.

(*Turn to page 70, please*)

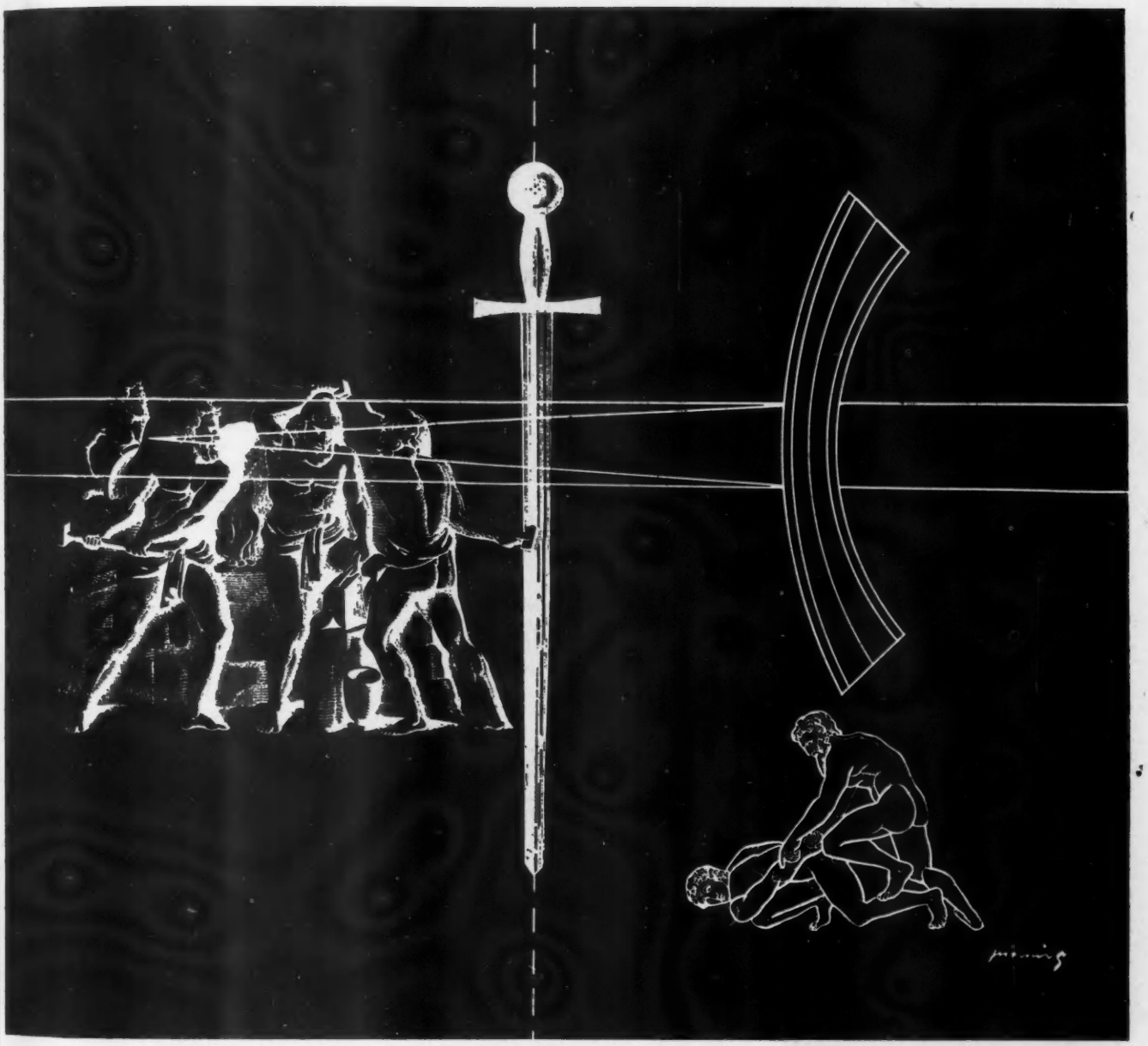


Koehler drain valve described on page 70

ONE CAME BACK

One of the legends surrounding the making of Damascus sword blades is that the smiths developed a delayed quench consisting of thrusting the heated blade into the body of a slave. This gave the required properties, but it was prodigal of manpower, and inconvenient besides. The smith usually had to leave town to do his heat treating in quiet.

Today, metallurgists can obtain properties they need in steel by simpler, less improvident means. A little molybdenum is one way of doing this. It is a proved means of obtaining the hardenability that assures good performance in service. Practical working data on molybdenum steels are available from Climax upon request.



MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

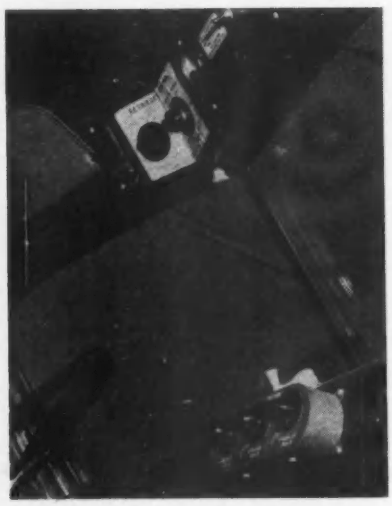
Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

New Products

Braking System for Heavy-Duty Vehicles

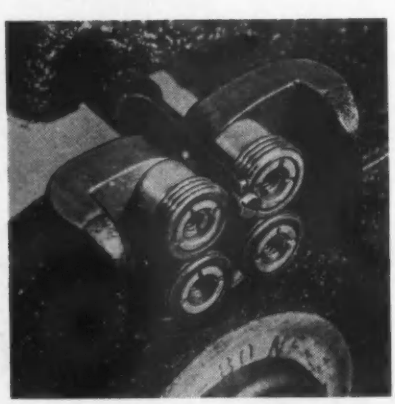
A new, dual electrical braking system has been developed for heavy-duty vehicles by the Warner Electric Brake Co., Beloit, Wis. Actually, two independent braking systems are used in this new application. One of these is an electric retarder mounted on the drive shaft of the tractor and on a live axle of the trailer, employing the principle of the Eddy current brake. A separate system of conventional shoe brakes on all wheels is controlled by an electro-magnetic circuit operated by an ordinary brake pedal.



Warner brake controls in truck cab. Two upper dials control electric Retarders on tractor and trailer. Three dials on instrument panel control independent electro-magnetic wheel brakes.

The Warner Retarder is a simplified form of electric generator. When excited, it produces a braking effect by generating electric current which is converted into heat and dissipated by the cooling fins of the retarder rotor. The action of the retarder is controlled by two speed and load control rheostats mounted in the cab. One of these controls the speed at which the retarder goes into operation, offering a range between 14 and 44 mph. The other controls the torque on the unit. In actual operation, the driver sets the first control for the desired speed and the torque control at a point commensurate with the grades being traversed and the load he is carrying. A micro-switch on the accelerator cuts out the unit so long as there is any pressure on the pedal. The moment pressure is released, the retarder goes into action holding the speed within narrow limits of the desired setting. For emergency stops, a micro switch on the brake pedal activates the retarder to full capacity at the instant the pedal is touched, regardless of the speed rheostat setting.

Related to the retarder is a separate system of conventional shoe-type wheel brakes operated by an electro-magnet device incorporating specially compounded Thermoid friction materials which activate conventionally-lined brake shoes. One most interesting feature of this system is the finger-tip control by the driver individually on each axle of the train. Three rheostate are mounted on the instrument panel. Each one controls the amount of current going into the magnetic circuit on each axle and thus controls the percentage of braking energy. This permits the driver to balance his brake action, while in motion, to compensate for changes in load and in driving conditions and for any variation in the condition of the brakes on tractor or trailer.



Pratt & Whitney roll thread comparator

Roll Thread Comparator With Pressure Control

In order that small diameter hard-to-handle screws of fine pitch can be easily and accurately inspected, Pratt & Whitney, Division Niles-Bement-Pond Co., West Hartford 1, Conn., has designed the new Model C-roll thread comparator with pressure control.

Its use is recommended by the manufacturer for builders of fine instrument and related industries when thread inspection is necessary on screws of diameters ranging from 0.060 in. to 0.216 in. and threads of 80 to 28 per in. National Form 60 deg.

The Model C comparator uses the J-S gaging principle with a pressure control feature which relieves the operator of the responsibility of judging borderline cases. The signal light instantly shows the result of full "go" and "not go" functional check on pitch diameter, minor diameter, lead and angle.

The screw is placed in the work holder where it is held on its major diameter. The operating lever is depressed and the screw is presented to the gaging rolls. The light is always on except when excessive pressure is applied at which time the light goes out. This feature provides an accurate and sensitive pressure control. This gaging pressure is adjustable to suit the work.

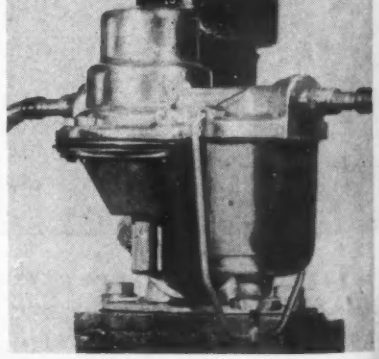
Correctly threaded screws pass the "go" rolls without resistance (light on), but will not pass through "not go" rolls without resistance (light goes out). Oversize screws meet resistance at "go" rolls (light goes out) while undersize screws pass through "go" and "not go" rolls (light stays on).

New Additions to Line of General Electric Co.

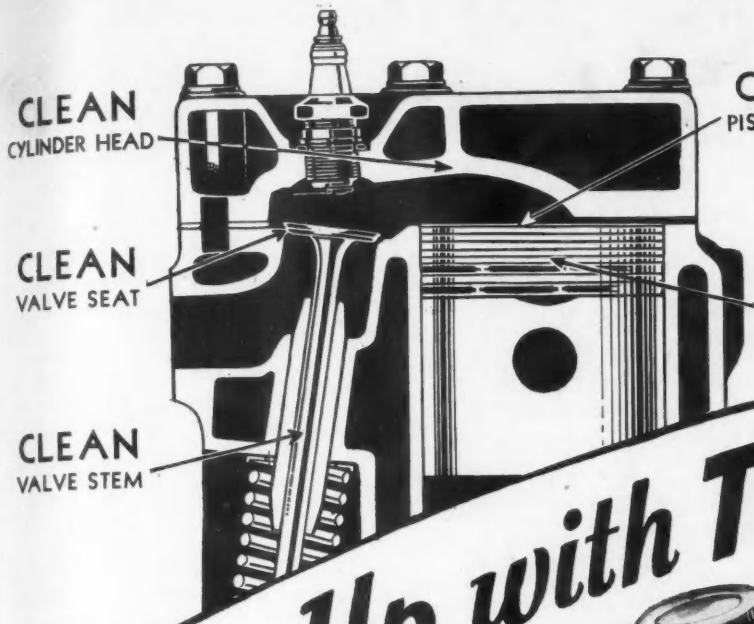
A new line of oiltight push-button units, selector switches, and indicating lights especially designed for the machine tool and automotive industries has been introduced by the Control Division of the General Electric Co. Protection against entrance of oil is provided throughout the line by a diaphragm seal and a rubber gasket. The gasket prevents oil from creeping in along the mounting bushing, while the diaphragm keeps it from entering be-

(*Turn to page 94, please*)

Jacobs Fuel Pump



Pictured above is a new-type automotive fuel pump developed by the F. L. Jacobs Co., 1043 Spruce St., Detroit 1, Mich. Engineering has been completed for this addition to the company's automotive line.



Tune-Up with TOON-OYL

by

PERMATEX

Before you Tune-Up MECHANICALLY ... Tune-Up CHEMICALLY!

FIRST, add PERMATEX TOON-OYL to crankcase oil and let car idle. Sludge and gum binders that interfere with the smooth operation of valves, piston rings, oil lines and oil screens, instantly will be dissolved!

THEN you'll have a CLEAN ENGINE, ready for accurate, thorough mechanical adjustments!

PERMATEX COMPANY, INC., BROOKLYN 29, N. Y.

℞

ADD 1 QUART OF PERMATEX TOON-OYL TO 5 OR 6 QUARTS OF ANY TYPE OF MOTOR OIL IN THE CRANKCASE

NEWS *of the* Industry

Production Still Threatened by Impending Labor Trouble and Materials Shortages . . . Wage-Price Future of All Companies May Depend Upon Outcome of Chrysler Negotiations . . . Coal Strike Would Curtail Steel Production Sharply and Soon . . . October Production Rate at New High But is Behind Original Estimates . . . Kaiser-Frazer Corp. Not Affected by Steel Shortage . . . Misleading Statistics May Again be Used by Unions to Support Wage Raise Demands.

With a record month of production behind it in October, the automotive industry entered the last two months of this year with prospects for continued high production clouded by impending labor trouble and an unsolved problem in materials shortages, principally sheet steel, lead, pig iron, and copper, in that order of importance. At the outset of November, Ford cut schedules 10 per cent because of the sheet steel situation, and Chrysler was deep into its wage increase negotiations with the UAW-CIO. Ford also had a strike threat on its hands revolving around its action in disciplining 18 workers for their part in an unauthorized 10-day strike in the company's open hearth unit, which resulted in the loss of 17,000 tons of steel by Ford estimates. While there is some doubt that a strike at either Chrysler or Ford will materialize very soon, if at all, the fact that union politics is an unpredictable hazard cannot be discounted too heavily, and the situation imposes a threat to say the least.

All Industry Watching Chrysler Negotiations

The eyes of the entire automotive industry are on the Chrysler negotiations, because it is an accepted belief that on the outcome will depend the wage price future of all companies. Just as the 18½ cent pattern became the common denominator for the industry last year, it now is quite certain that whatever concession the union is able to wring from Chrysler will be the pace setter for all subsequent demands on other companies. While the union has not made public its demands on Chrysler, it is believed that the figure is 20 cents an hour as a minimum, with a larger amount if the price of living keeps rising. There is marked difference between the present wage talks and the G.M. negotiations last winter. At that time, a great deal of fire and fury came out of the union headquarters with the Corporation replying with public statements. The battle was fought in the press as much as in the conference room, both sides making determined bids for public support. With neither the union nor Chrysler divulging much of anything about progress of the talks, it is more difficult to know just what is happening now. However, it has been established that the union is basing its claims for higher wages on the increase in the cost of living which it contends has risen 12½ per cent since the first of the year and will rise 20 to 25 per cent by the end of December. The ability-to-pay theory is not being pressed as hard as in the G.M. case, but still is very much alive. The union holds that even at present production levels, Chrysler can afford to grant substantial wage increases without price increases for its products. Apparently, the experience with this discredited theory has been conveniently forgotten. What the industry is afraid of now is that any further wage increases, without a commensurate boost in production, will price automobiles out of the market for a large segment of buyers, a situation which many observers believe has already happened. The outlook is not happy.

Coal Strike would Soon Curtail Steel Production

As if the automotive manufacturers did not have enough labor trouble on their own doorstep,, they now have to worry about the effects of a coal strike on the production of steel, already critically short. Opinion in the steel industry is that if a coal strike materializes, curtailment of schedules will come rapidly because there is not enough of a backlog of coal to carry full operations for an extended period. On the basis of past experience, however, the general belief is that the government will capitulate to John L. Lewis again.

October Production High But Behind Estimates

Although the output of cars and trucks during October hit a new high for the postwar period with an unofficial estimate of about 410,000, it was again behind projections made at the outset of the month. November estimates have been revised in the light of Ford's decision to cut production 10 per cent and it now appears that output this month probably will be about equal to that of October. Passenger cars are expected to drop off a few thousand units, but truck production appears to be on the gain, so that the net result will be about the status quo. Apparently, most companies have their schedules set for the rest of this year based on the forseeable supply of sheet steel, and there is nothing visible at present that would indicate any chance for an appreciable gain. Thanksgiving comes this month, and with most plants not planning to work the following Friday, two production days will be lost.

Kaiser-Frazer Not Hit By Sheet Steel Shortage

One automotive company that has no particular worries about the shortage of sheet steel is the Kaiser-Frazer Corp. J. W. Frazer, president, told a group of distributors recently that the company has enough steel on hand or in sight to build 1000 cars a day. He said that K-F has its own steel and blast furnaces and that it has been trading some of its steel and pig iron for other scarce raw materials. He also said that production goals call for a daily schedule of 1500 cars a day by next April, but that enough steel for that production is not yet in sight. However, the company is negotiating for a steel mill in South Chicage operated during the war by Republic Steel Corp. Present production at the Willow Run plant is between 125 and 150 cars a day.

Statistics Again To Be Part Of Union Wage Raise Strategy

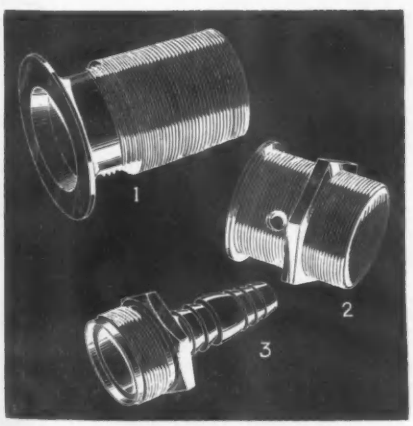
The voluminous compilation of statistics and economic data which the union used to support its claims in the General Motors strike last year are a part of recorded industrial history, but they are not a dead issue. That the so-called facts proved to be largely phony conjectures has not deterred the union from resorting again to government figures which purport to show that profits in the first half of 1946 were more than double those of the same period the year before. Frank Rising, general manager of the Automotive and Aviation Parts Mfrs. Assn. comments that UAW-CIO spokesmen are not likely to mention that the businesses used to head the profit increase report are retail trade, motion pictures, radio

(*Turn to page 78, please*)

CAST THREADS SHOULD ALWAYS BE CONSIDERED

If threads are required on a die casting, the designer should carefully consider the possibility of effecting economies by *casting* instead of *cutting* them. External threads are easily cast if they are coarse, or over ¾" pitch diameter, and are located at a die parting. The flash which occurs on such threads can easily be removed in a simple trimming operation. Internal threads are sometimes cast when very steep pitches are called for.

Illustrated below are three *zinc alloy* die castings with cast external threads. #1 is a flanged plumbing drain with a 14-pitch thread, 1½" in diameter and 1¾" long. #2 is an electrical bushing with a 24-pitch thread to accommodate a die cast nut. This thread is 1⅜" in diameter and 1⅜" long. #3 is a hose nipple with a 1" diameter 24-pitch thread which is $\frac{9}{16}$" long. Finer threads than these are seldom cast.



NEW TYPE SPRINGLATCH IS DIE CAST

The new door latch shown below has a *zinc alloy* die cast latch body and striker. This is known as the "one-arm springlatch" since it is designed to permit a door to be unlatched and opened with one hand—a great advantage when you arrive home with an armful of bundles. The manufacturer of this latch adopted die castings for the principal parts because of favorable experience with this method of production for many other items in an extensive line.

The *zinc alloy* die cast latch body is of particular interest since only a few simple operations—trimming, drilling and tapping—are required to prepare this part for assembly, (see photograph next column—top, as-cast—bottom, as-machined). All of the elements for assembling the lock mechanism are obtained in the casting operation, and the as-cast surfaces are readily finished with a good-looking lacquer-enamel coating which has the appearance of dull brass.

This die casting application is covered in greater detail in the current issue of our die casting publication, "The Alloy Pot". If you are not receiving this publication regularly, just drop us a line. Also ask us—or your die casting source—for a copy of "Designing For Die Casting".

Send for your copy

ZINC
FOR DIE CASTING ALLOYS

The New Jersey Zinc Company, 160 Front St., New York 7, N. Y.

The Research was done, the Alloys were developed, and most Die Castings are based on
HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC

Publications Available

Publications listed in this department are obtainable by subscribers through the Editorial Department of Automotive *and* Aviation Industries. In making requests give title above the item concerning the publication desired, the date of issue in which it appeared, your name and address, company connection and title.

Fixtures and Tooling

Barnes Drill Co.—Bulletin entitled Fixtures and Tooling which describes methods for low cost, rapid handling of a wide variety of work. Application of hydraulic production units and electrical, pneumatic or manually operating holding and indexing means is illustrated by views of actual machine set-ups on honing, drilling, tapping, reaming, threading and other operations. Typical results are shown in time and production figures.

Draw-In Collets

Hardinge Brothers, Inc.—Bulletin No. 46, giving full information on Hardinge Draw-In Collets for all lathes and millers and the Hardinge-Sjogren Collet Chucks.

Welding Technique

Ampco Metal, Inc.—Revised edition of Bulletin W-2a, Ampco-Trode Welding Technique features the welding of aluminum bronze electrodes by the carbon and metallic arc methods. It contains a weldability chart for copper base alloys and is illustrated with photographs, sketches and diagrams. A table of recommended currents and voltages is included.

Roller Hearth Furnaces

Surface Combustion Corp.—Bulletin SC-132 describes the company's prepared atmosphere roller hearth furnaces for ferrous and non-ferrous bars, tube and strip. Furnace operating data are included in the bulletin.

Induction Heating

The Ohio Crankshaft Co., Tocco Div. —Bulletin by H. B. Osborn, Jr., the company's director of research, covers the general history, principles and applications of induction heating, and deals specifically with many of induction heating's most technical considerations. The booklet contains many pictures, charts and graphs.

Seam Welders

Progressive Welder Co.—Bulletin 803, an 8-page 2-color folder, gives information on the design, operation and applications of Progressive improved standard and special seam welders. The bulletin is well illustrated.

Thermosetting Resin

B. F. Goodrich Chemical Co.—Kriston Thermosetting Resin is the title of a 12-page illustrated technical bulletin covering properties and processing information for the new thermosetting allyl ester casting resin manufactured by the company.

Lamp Bulletin

General Electric Co., Engineering Div., Lamp Dept. — 76-page technical treatise entitled G-E Bulletin LD-1, prepared by Mr. C. E. Weitz, of the Lamp Dept. It features the latest lamp developments and their practical applications in many fields in commerce, industry and home. The bulletin is well illustrated throughout with photographs, diagrams and charts.

Contact Springs and Assemblies

Gibson Electric Co.—Bulletin B-61 describes their beryllium copper electrical contact springs and contact assemblies. Electrical and mechanical properties are included.

Spray Booths

Newcomb-Detroit Co.—A new catalog describing the Water Tube Spray Booth contains the working principle and complete specifications of the booth. Comprehensive descriptions are amplified by numerous pictures and drawings.

Personals

Recent Personnel Changes and Appointments at the Plants of Automotive and Aviation Manufacturers and Their Suppliers.

Ford Motor Co.—**D. S. Harder**, Vice-Pres., in charge of Operations.

Ford Motor Co.—**Paul O. Larsen**, Mgr., Kansas City district.

Ford Motor Co.—**Victor G. Lottmann**, Director of Commodity Research.

Ford Motor Co.—**Harry G. Smith**, in charge of Ford engine design, Engineering Div.

Ford Motor Co.—**Lewis D. Crusoe**, Director of Planning and Control Div. and **Harold T. Youngren**, Director of Engineering Div., have been made vice-presidents of the company.

Ford Motor Co.—**Dean L. Sellers**, Asst. General Sales Manager, in charge of eastern half of the United States; **L. W. Smead**, Asst. General Sales Manager, in charge of western half of the United States.

General Electric Co.—**Lawrence L. Jones**, Supt. of new factory for manufacture of Clyptal alkyd resins at Anaheim, Calif.

H. K. Porter Co., Inc.—Hinderliter Tool Co.—**George A. Hays**, Vice-Pres. and General Mgr.

Muskegon Piston Ring Co.—**A. Verne Jackson**, Sales Representative for Detroit.

General Motors Corp.—**George A. Jacoby**, Director of Personnel Dept.'s Service Activities Section.

Chrysler Corp., Plymouth Div.—**Bruce K. Steele**, Director of Regions.

Gardner-Denver Co.—**G. V. Leece**, appointed General Sales Manager.

American Brake Shoe Co., American Manganese Steel Div.—**A. R. Sittig**, Mgr. of Manganese Steel Sales; **E. L. Quinn**, Asst. Vice-Pres. in charge of Welding Products; **E. J. Nist**, Asst. Vice-Pres. with headquarters in New York City.

Progressive Welder Co.—**W. C. Kegg**, Personnel Director.

The White Motor Co.—**Harold A. Manderson**, Director of Purchases.

Galvin Manufacturing Corp.—**Paul K. Povlsen**, Asst. to the President.

The B. F. Goodrich Co.—**Herman V. Gaertner**, Controller.

National Broach and Machine Co.—**Walter S. Praeg**, President; **J. Irvin Schultz**, Vice-Pres. and Treasurer.

Luscombe Airplane Corp.—**William C. Scurry**, elected to board of directors.

Fairchild Engine and Airplane Corp., Fairchild Aircraft Div.—**A. Paul Fonda**, Military Sales Manager.

United States Steel Corp.—Dr. **John Johnston** retiring as Director of the Research Laboratory.

Kaiser-Frazer and Graham-Paige Motors—**John L. Hallett**, Vice-President and Chief Engineer; **John C. McFarland**, Manager, Body Div.

Gar Wood Industries, Inc.—**Clifford A. Sharpe**, elected vice-president in charge of manufacturing.

E. W. Bliss Co.—**Marshall M. Smith** elected President.

United States Rubber Co., U. S. Tires Div.—**John A. Boll**, Mgr., newly formed Detroit Div.; **William J. Palmer**, Divisional Mgr. for Eastern Div.

Snyder Tool & Engineering Co.—**William C. Oberem**, has resigned as chief engineer and **George D. Melling, Jr.**, has been appointed to fill the vacancy.

American Foundry Equipment Co.—**Ardee H. Freeman**, Special Project Engineer; **James H. Thomson** succeeds Mr. Freeman as district sales engineer for Milwaukee.

Timken Roller Bearing Co., Timken Steel and Tube Div.—**H. B. Lilley**, District Mgr. of the Div. with headquarters in Houston, Texas. **Russell P. Proffitt**, District Mgr., Washington, D. C. office.

O. K. Tool Co.—**E. B. Andrews**, Sales Manager.

General Electric Co., Lamp Dept.—**John A. Buckley**, Merchandise Sales Manager.

Pratt Industries, Inc., **S. A. Higginbottom**, appointed Vice-President.

Pioneer Engineering and Mfg. Co.—**Paul Hacker**, Operating Manager; **Ted Campbell**, Chief Die Engineer.

Federal Machine and Welder Co.—**J. R. Barefoot**, Executive Assistant to **H. A. Stix**, Executive Vice-President and Treasurer.

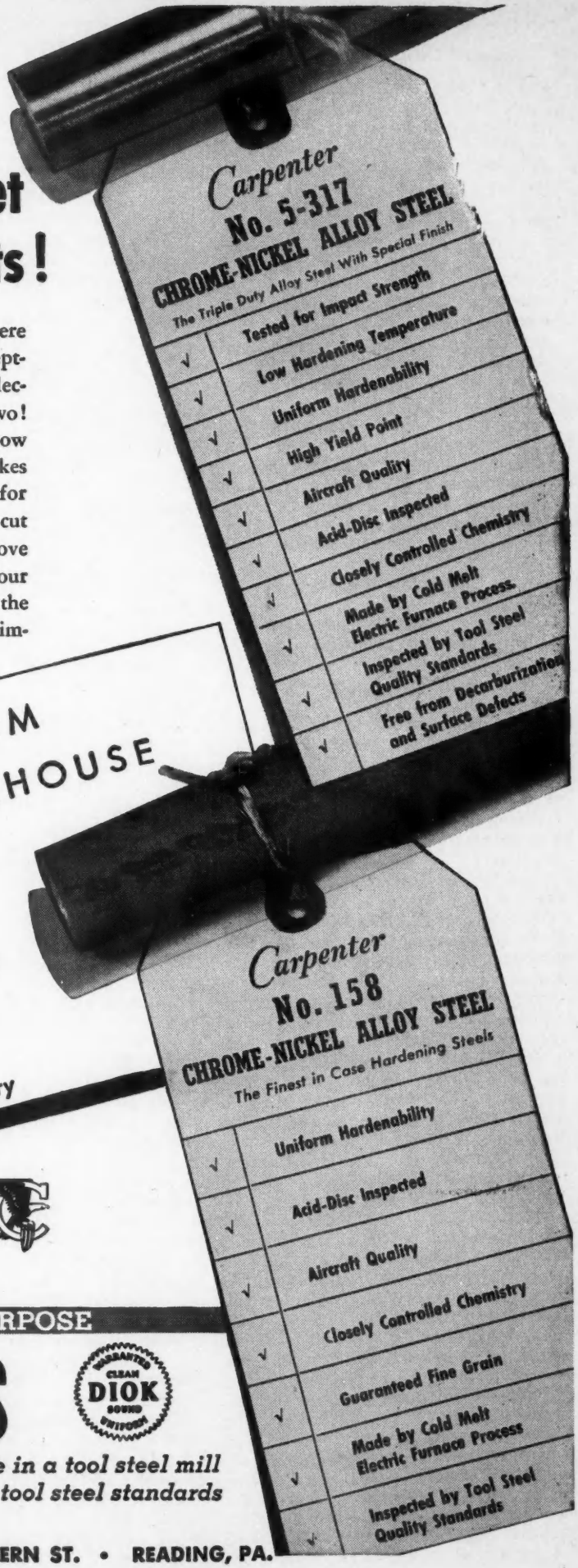
Portable Products Corp., **D. J. Hasinger**, Gen. Mgr., Paul and Beekman Div., Philadelphia.

Dr. Sanford A. Moss

Dr. Sanford Alexander Moss, 74, research engineer and inventor who developed the turbosupercharger, died Nov. 10 at Lynn, Mass.

2 Alloy Steels can meet 95% of your requirements!

For heat treated gears, bolts, shafts, etc.—where you once had to select from dozens of acceptable alloy steels, you can now simplify selection, fabrication and inventory with these two! Check the properties of the steels you are now using against this Carpenter "team" that makes your job easier all along the line. And for more information on how these steels can cut your production costs, improve product performance, ask your Carpenter representative for the new folder, "Two Steels to Simplify Your Alloy Needs."


Carpenter
No. 5-317
CHROME-NICKEL ALLOY STEEL
The Triple Duty Alloy Steel With Special Finish
√ Tested for Impact Strength
√ Low Hardening Temperature
√ Uniform Hardenability
√ High Yield Point
√ Aircraft Quality
√ Acid-Disc Inspected
√ Closely Controlled Chemistry
√ Made by Cold Melt Electric Furnace Process
√ Inspected by Tool Steel Quality Standards
√ Free from Decarburization and Surface Defects
Carpenter
No. 158
CHROME-NICKEL ALLOY STEEL
The Finest in Case Hardening Steels
√ Uniform Hardenability
√ Acid-Disc Inspected
√ Aircraft Quality
√ Closely Controlled Chemistry
√ Guaranteed Fine Grain
√ Made by Cold Melt Electric Furnace Process
√ Inspected by Tool Steel Quality Standards

AVAILABLE **NOW** FROM YOUR *Carpenter* WAREHOUSE

BUFFALO
CINCINNATI
DAYTON
HARTFORD
NEW YORK
CHICAGO
CLEVELAND
DETROIT
INDIANAPOLIS
PROVIDENCE
ST. LOUIS

See Your Classified Telephone Directory

Carpenter

SPECIAL PURPOSE

ALLOY STEELS

WARRANTED CLEAN DIOK SOUND PERFECT

... made in a tool steel mill
... inspected by tool steel standards

THE CARPENTER STEEL COMPANY • 103 W. BERN ST. • READING, PA.

MEWA to Hold First Postwar Convention

The first postwar Convention of the Motor and Equipment Wholesalers Association will be held in Atlantic City on Dec. 6 and 7, 1946, preceding the Automotive Service Industries Show which will be held beginning Monday, Dec. 9 through Sat., Dec. 14 at Atlantic City, N. J.

The M.E.W.A. National Convention will open on Friday, Dec. 6 at 10 AM in Cambridge Hall at the Hotel Claridge. The morning session will be devoted to addresses by several nationally prominent speakers and by president Franklin P. Gaul of the M.E.W.A. and B. W. Ruark, general manager of M.E.W.A.

The afternoon session will be made up of a panel presentation titled "Guide Book to More Profitable Customer Meetings" which will be presented by the members of the Automotive Advertisers Council. This panel will consist of six members of the Council headed by T. Faxon Hall, president of the A.A.C., and sales promotion manager of Walker Manufacturing Co. The Moderator for this panel will be John E. Peters, assistant to the general manager of M.E.W.A. This panel will discuss quite fully the many important points brought out in the new booklet that has been prepared and published by the Automotive Advertisers Council for the benefit of all automotive wholesalers in the planning and follow-through for a more profitable clinic and general customer meeting. Also on Friday afternoon there will be a very comprehensive presentation made covering the advertising and merchandising program being conducted by the M.E.W.A. Carl J. Hendricks, Motive Parts Co. of America, Chicago, who is chairman of the Association's Advertising Committee, will be the presiding officer at this presentation. He will be assisted by Morrill Palmer, Trackman Auto Supply Co., Joliet, Ill., a member of the M.E.W.A. Advertising Committee, and Burton Browne and E. W. Stephenson of the Burton Browne agency, advertising counsel for the Association.

On Saturday morning two interesting addresses will be given, one by Vincent B. Coffin, vice president, Connecticut Mutual Life Insurance Co., whose talk will be titled "After All, It's Common Sense," and by Clare A. Johnson, Director of Organization, National Tax Equality Association, whose talk will be titled "Tax Free Competition—What Next." This will be on the subject of co-ops and their present evasion of taxes which should be extremely interesting and important to all business generally. Another interesting panel presentation will be made on Saturday morning entitled "Sales Management Takes Command." This panel discussion will be made by four of the leading automotive wholesale distributors who are members of the M.E.W.A. and are well qualified to discuss the problems of sales management and what the outlook will be on this phase of distribution in the coming battle of increasing business competition. Millard F. Shryer, National Field Representative of the M.E.W.A., will act as Moderator for this panel. Saturday afternoon there will be special regional discussion clinics arranged for members of the Association. This part of the Convention will probably be developed after certain consultation with members of the M.E.W.A. Board of Directors who will be meeting in a regular session on Thursday, December 5.

ASI Show to be Held in Atlantic City, N. J.

On Monday morning, Dec. 9, at 9 AM the Automotive Service Industries Show will open at the Atlantic City Auditorium, Atlantic City, N. J. This 1946 Show will be the first one to be held since December of 1940 when the Show was held at Navy Pier in Chicago. This ASI Show will be the 22nd Show, the first one being held in 1919 at the old Masonic Temple in Chicago and from that year until 1940 there were 21 consecutive Shows held.

This year the Show will be the largest ever to be held in the Automotive Aftermarket Industry. Approximately 420 automotive parts, equipment, supplies and accessory manufacturers will occupy a total of 1,100 booths totalling over 125,000 sq ft of display space. Both levels of the Auditorium at Atlantic City will be used to house this gigantic exposition. Although many manufacturers who will be present are not in a position to present their latest products because of numerous reconversion problems, there will be interesting exhibits and presentations made by all those taking space.

Monday, Dec. 9, through Wednesday, Dec. 11, the Show is open to only members of the three sponsoring associations which are the Motor and Equipment Wholesalers Ass'n, the Motor and Equipment Manufacturers Ass'n and the National Standard Parts Ass'n. Beginning Thursday through Saturday invited wholesale guests also will be in attendance. These firms will be selected from lists supplied by the three associations. There will be no open trade day for the retail or service end of the automotive maintenance business at this year's show. Show hours will be from 9 AM to 5 PM. Many social affairs will be held during the Convention days and during Show week. Outstanding among them will be the International Boosters' Club Silver Anniversary Banquet which will be held on Tuesday evening Dec. 10 in the Ballroom of the Auditorium and the Overseas Automotive Club Dinner which will be held on Wednesday, Dec. 11 at the Traymore Hotel. It is expected that there will be close to 1,000 men from foreign countries attending this year's ASI Show.

GM Increases Prices of Passenger Cars by $100

General Motors on Nov. 11 raised factory list price of all passenger car models made and sold in the United States by one hundred dollars, effective at once. Prices of all Chevrolet trucks were increased one hundred dollars and corresponding models produced by GM Truck and Coach were increased a similar amount. Prices of larger trucks made by GMC had previously been adjusted by OPA action, and there will be no general change at this time. OPA had also raised replacement parts prices by 15 per cent and no general adjustment of parts prices at this time is contemplated. Charles E. Wilson, president of General Motors, said that the one hundred dollar increase had been under consideration by OPA for two months, and the adjustment places GM car prices on a more reasonable relation to greatly increased cost of production. He said that even so, GM prices still will be relatively low compared with the competition and with prices now charged for many other goods and services.

Weekly Production of Cars and Trucks in U. S. and Canada

Week ending		1946	Corresponding Week in 1941
Jan.	5	13,920	76,935
	12	23,340	115,935
	19	28,465	124,025
	26	29,410	121,948
Feb.	2	29,295	124,400
	9	23,785	127,675
	16	21,555	127,510
	23	19,410	127,740
Mar.	2	17,575	126,550
	9	23,050	125,915
	16	35,020	131,410
	23	37,285	123,805
	30	43,070	124,165
Apr.	6	47,735	116,255
	13	49,425	99,260
	20	57,565	99,945
	27	64,620	108,165
May	4	67,060	130,610
	11	71,335	132,380
	18	48,565	127,255
	25	53,020	133,560
June	1	31,895	106,395
	8	43,175	133,645
	15	50,206	134,632
	22	54,475	133,565
	29	60,015	127,926
July	6	45,175	96,457
	13	74,015	114,318
	20	80,395	109,912
	27	84,720	105,635
Aug.	3	79,385	62,146
	10	77,825	41,795
	17	88,990	45,550
	24	91,360	45,525
	31	74,960	39,965
Sept.	7	72,535	32,940
	14	88,888	53,165
	21	80,972	60,615
	28	86,582	77,035
Oct.	5	91,925	76,820
	12	86,330	79,065
	19	89,540	85,600
	26	87,680	91,855
Nov.	2	95,752	92,879
	9	92,490	93,585
Total		2,521,865	4,566,518

The Bendix Direct Fuel Injection System

This Bendix-developed Direct Injection Fuel System was used on wartime B-29s that delivered the atomic bombs . . . the "Pacusan Dreamboat" that flew over the top of the world and later set a new Paris to United States speed record . . . and today is in use on the great airliners that span the Atlantic and Pacific.

Details of this new fuel feed system, that injects gasoline directly into each engine cylinder, will be made public as soon as defense considerations permit. Bendix Products Division, Bendix Aviation Corporation, South Bend 20, Ind.

Bendix* creative engineering helps American aviation lead the world

Bendix
PRODUCTS DIVISION
Bendix
AVIATION CORPORATION

*REG. U.S. PAT. OFF.

Tucker and Lustron May Occupy Dodge Plant

Possible joint occupation of the disputed Dodge-Chrysler plant in Chicago by the Lustron Corporation, maker of pre-fabricated houses, and the Tucker Corporation, automobile manufacturers, was indicated by issuance on Nov. 4 of a revised allocation order by Housing Expediter Wilson W. Wyatt.

The new order directed War Assets Administration to not only permit Lustron officials to inspect unused portions of the plant but to make available to them all information concerning size and composition of the entire facility.

At the same time, WAA was ordered by NHA to lease to Lustron any and all portions of the plant considered necessary to the firm but excluded from immediate delivery "any part of the plant already occupied by the Tucker Corporation or leased by WAA to any other party."

As to the ultimate disposition of the Tucker-occupied parts of the plants, this is left in doubt by the NHA action which also ordered WAA to render a report showing "specifically the part of the plant now in interim use and to await further directives concerning disposition of such parts of the plant."

A series of conferences have been held at which two proposals were considered, first, joint occupation and, secondly, that the Tucker firm use another plant, such as the Curtiss-Wright facilities at Lockland, Ohio. As an added inducement to Tucker, NHA has tossed in an offer to release the Lockland plant from its existing freeze offer and to assist in getting terms so favorable as to wipe out any loss incurred by locating at the Ohio site.

Also still muddying the picture is the refusal of RFC to loan Lustron the $30 million or so it has asked to set up in business under NHA's guaranteed market plan. Housing officials have stated that if RFC does not voluntarily "reconsider" its refusal to make the Lustron loan, then NHA will "most certainly" issue another directive which would compel the loan agency to make funds available.

Mr. Wyatt, speaking at a press conference, declared that he was "optimistic" concerning his power and authority under temporary legislation plus executive order to compel RFC to make the loan to Lustron or other housing manufacturer.

Questioning the authority of Wyatt to order cancellation of government sales contracts or leases, WAA referred the original allocation order over to the Department of Justice for an opinion as to its legality. No decision has been announced by Justice.

STERLING-
Specialists in Aluminum Permanent Mold Castings
Sterling's modern foundry, patented molding process, quality materials, and expert workmanship have been, for years, producing the finest in aluminum pistons.
This same expert workmanship and patented molding process has enabled us to develop many special permanent mold aluminum castings for the automotive and aviation industries.
Wherever a minimum of finishing and light weight is a factor, our engineers' experience will be of value to you in developing a permanent mold aluminum casting to economically meet your requirements. Call or write
STERLING ALUMINUM PRODUCTS INC.
St. Louis 6, Missouri

CALENDAR

Conventions and Meetings

Natl. Aircraft Show, Cleveland..Nov. 15-24
French Aero Show, Grand Palais, Paris Nov. 15-Dec. 1
American Welding Society Annual Meeting, Atlantic City .....Nov. 17-22
American Assoc. Motor Vehicles Adm. Annual Mtg., San Francisco..Nov. 18-21
Natl. Metal Congress and Exposition Atlantic City .....Nov. 18-22
Automobile Old Timers Annual Mtg., New York .....Nov. 20
SAE Natl. Air Transport Engineering Mtg., Chicago .....Dec. 2-4
National Wheel, Rim Assoc., Annual Meeting, Chicago .....Dec. 4-7
Natl. Standard Parts Assoc. Conv., Atlantic City .....Dec. 6-7
Motor & Equip. Wholesalers Assoc. Convention, Atlantic City .....Dec. 6
Society for Experimental Stress Analysis, Annual Mtg., New York..Dec. 9-11
Automotive Service Industries Show, Atlantic City .....Dec. 9-14
Int. Aviation Celebration & Exhibition, El Paso .....Dec. 12-15
SAE Annual Mtg. & Eng. Display, Detroit .....Jan. 6-10
Natl. Assoc. of Eng. & Boat Mfrs. Motor Boat Show, New York City, Jan. 10-18
Natl. Materials Handling Exposition, Cleveland .....Jan. 14-17
New York Aviation Show, Grand Central Palace, New York City .....Feb. 1-8
Amer. Soc. for Testing Materials—Spring Mtg., Phila. .....Feb. 24-28
Amer. Society for Metals, San Francisco .....Mar. 22-27
Midwest Power Conference, Chicago, Mar. 31-Apr. 2
Nat'l Assoc. Corrosion Engineers National Convention, Chicago...April 7-10
Amer. Society for Testing Material, Annual Mtg., Atlantic City..June 16-20

Kodak

KODAK TRANSFAX PROCESS

Here is how it works . . .

YOU SPRAY TRANSFAX . . . a white, light-sensitive, quick-drying material . . . on your product-surface. Some surfaces need special primers.

You place on the Transfax-coated surface a transparent or translucent original of the design or legend, and expose to strong light.

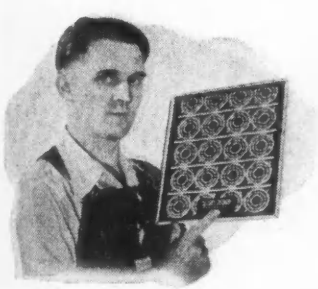
You wash the surface with a weak ammonia solution.

You get a Transfax reproduction of the original which is accurate, tough, rubproof, oilproof.

You get it quickly . . . at low cost . . . without a darkroom . . . and the job can be handled by anyone with ordinary skill.

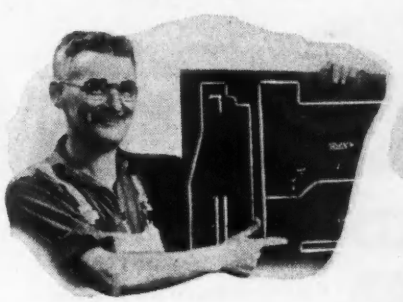
Here are 4 possible uses . . .

. . . for name plates or monograms

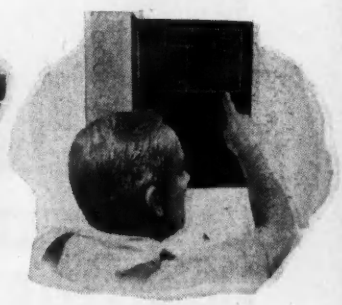


. . . for dials or scales

. . . for fabricating directions



. . . for wiring or piping diagrams



To learn more about how Transfax works . . . for information that will help you determine its usefulness in your business . . . mail the coupon.

EASTMAN KODAK COMPANY
Industrial Photographic Division · Rochester 4, N. Y.

TRANSFAX

Saves time . . . ends error . . . speeds production

Mail this coupon for *Free* folder

Eastman Kodak Company
Rochester 4, New York

Please send me your free folder on the Kodak Transfax Process.

Name _____

Company _____ Dept. _____

Street _____

City _____ State _____

MEMA to Hold Annual Meeting

The Annual Meeting of members of the Motor and Equipment Manufacturers Association will take place Tuesday, Dec. 10, 1946, at the Traymore Hotel in Atlantic City, N. J.

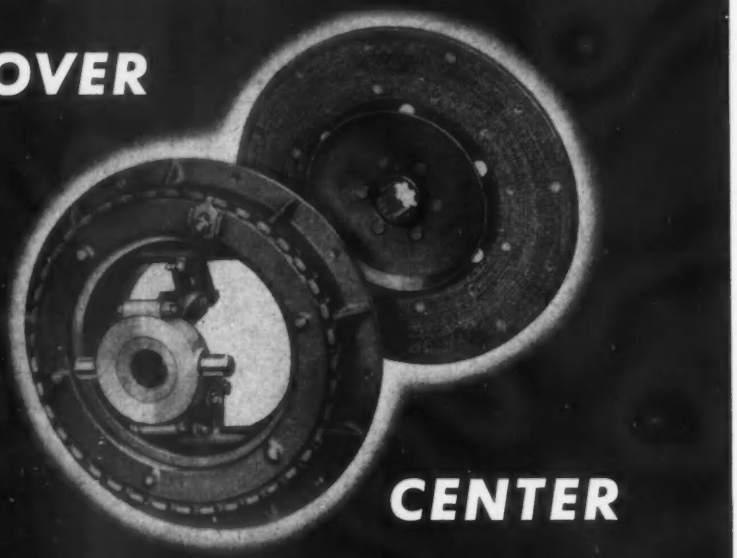
From 6:30 to 7 PM, there will be an informal reception in the Traymore Hotel Rose Room. At 7 PM, there will be an informal dinner in the Traymore Hotel American Room, followed by a brief business meeting.

After the business meeting Robert R. Wason, president of the National Association of Manufacturers and president of Manning, Maxwell & Moore, Inc., of New York City, will address members on "A Business Man Looks at the National Economy."

Chevrolet Observes Thirty-Fifth Anniversary

Chevrolet Division of General Motors marked its 35th Anniversary November 3 in first place in the 1946 automotive production race. Although behind Ford in the number of passenger cars turned out this year, combined truck and car production puts Chevrolet out in front by a comfortable margin that is not likely to be threatened. Observance of the anniversary was taken pretty much in stride with no interruption of production. Only formal recognition was a special display in the lobby of the General Motors Building in Detroit featuring a 1946 model painted in jade, the anniversary color, against a special commemorative medallion.

ROCKFORD OVER CENTER CLUTCHES



EASY OPERATION
HIGH TORQUE
POSITIVE ENGAGEMENT
LARGE DRIVING AREA
SMOOTH RUNNING
INFREQUENT ADJUSTMENT
MINIMUM INERTIA

* Anti-friction ROLLER CAMS — an exclusive feature — make ROCKFORD Over-Center CLUTCH operation extremely easy. A light pressure, lever-controlled, toggle-joint arrangement moves the high point of the cams "over center".

Send for This Handy Bulletin

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD CLUTCH DIVISION BORG-WARNER
315 Catherine Street, Rockford, Illinois, U.S.A.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE *and* AVIATION INDUSTRIES

New advances in general business activity are indicated. The *New York Times* index for the week ended Oct. 26 stands at 138.5, as against 134.1 for the preceding week and 118.9 a year ago.

Electric power production increased slightly in the week ended Oct. 26. The output was 16.9 per cent above the corresponding amount in 1945, as compared with a like advance of 16.0 per cent shown for the preceding week.

Railway freight loadings during the same period totaled 942,257 cars—the maximum weekly number reported since August, 1930. This was 1.1 per cent more than the figure for the week before and 10.2 per cent above the corresponding number last year.

Crude oil production in the week ended Oct. 26 averaged 4,729,800 barrels daily, 2800 barrels less than the preceding average but 456,800 barrels above the comparable output in 1945.

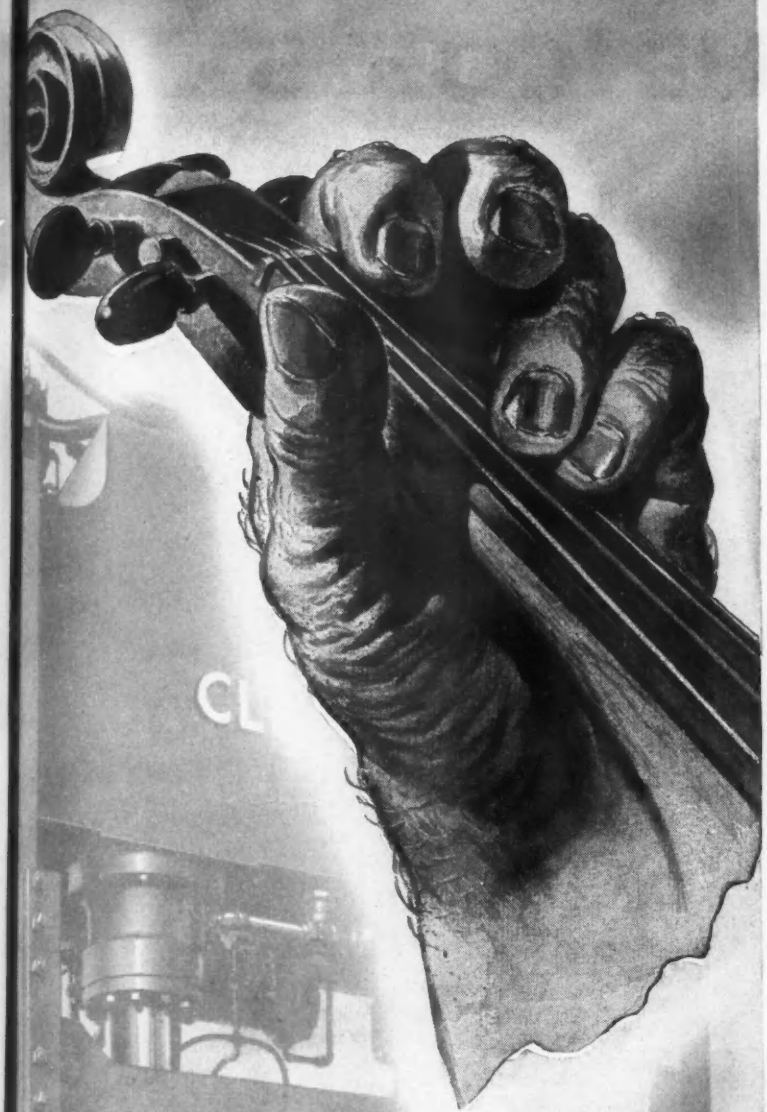
Production of bituminous coal and lignite during the week ended Oct. 19 is estimated at 12,510,000 net tons, 2.1 per cent above the output in the week before. The total production in 1946 so far reported is 7.2 per cent less than the corresponding quantity in 1945.

Civil engineering construction volume reported for the week ended Oct. 31, according to *Engineering News-Record*, is $109,385,000, or 98 per cent above the preceding weekly figure and 25 per cent above the comparable sum in 1945. The total recorded for forty-four weeks of this year is 151 per cent more than the corresponding amount in 1945. The increase in private construction is 244 per cent, and the rise in public construction is 77 per cent.

The wholesale price index of the Bureau of Labor Statistics for the week ended Oct. 26 is 135.9 per cent of the 1926 average, as compared with 135.1 for the preceding week and 105.7 a year ago.

Member bank reserve balances increased $332,000,000 during the week ended Oct. 30. Underlying changes thus reflected include an increase of $465,000,000 in Reserve bank credit and a rise of $93,000,000 in Treasury deposits with Federal Reserve banks, accompanied by an increase of $3,000,000 in money in circulation.

Total loans and investments of reporting member banks increased $451,000,000 during the week ended Oct. 23. A rise of $75,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, $9,622,000,000, shows a net increase of $3,356,000,000 in twelve months.



OVERTURE to Low Cost Production

You scarcely expect harmonious results when the huge, muscular fingers of a blacksmith assault the strings of a violin—that's a task demanding delicacy and agility, not overwhelming strength. Yet the sweetest music a cost-minded executive can hear comes from the combination of precisely these qualities in a production machine.

Everyone knows that a *press* delivers parts faster and at lower cost than any other available means of production. Conventional thinking is likely to overlook this extremely valuable asset when the parts to be produced are quite large or call for maintenance of relatively close tolerances. Clearing, on the contrary, has deliberately designed and built presses to make production dreams come true—presses of gigantic size and exerting tremendous pressures, yet so constructed as to hold tolerances unbelievably close. Such a press may be the answer to your cost problem.

When you think of Clearing presses it is well to forget previous conceptions as to press limitations. Many a Clearing press is today producing, in a single stroke, a part which formerly required much more complex and costly procedures. If you are seeking new ways to meet a coming competitive situation, Clearing engineers may be able to help you. It costs you nothing to consult us, to find out exactly what one or more Clearing presses can do to bring down your cost figures.

CLEARING

THE WAY TO EFFICIENT MASS PRODUCTION

Hydraulic press of 250 tons capacity built by Clearing for twisting crankshafts.

CLEARING MACHINE CORPORATION

6499 WEST 65TH STREET • CHICAGO 38, ILLINOIS

WHEN MACHINING COSTS

You need this Improved

MORE THAN MATERIAL...

MACHINABILITY

The sealing plug for aircraft hydraulic mechanisms at the left is a good example of what we're talking about. A lot of machining goes into its fabrication on hand screw machines and drill presses—machining which costs considerably more than the steel from which it is made.

That's why UNION SUPERCUT (A.I.S.I. B-1113) is used for this and countless other steel parts.

UNION SUPERCUT is an *improved* free-machining Bessemer Steel—improved not once but many times. It is the steel which, because of its high machinability, made necessary the redesign of automatic screw machines. It is the steel which for uniform machinability has led the field ever since it first was developed.

In the production of UNION SUPERCUT. UNION FREE CUT (B-1112) or any of the open-hearth or electric furnace grades produced by Union Drawn Steel Division, *MACHINABILITY* always gets top consideration.

As a result, speeds and feeds have been repeatedly increased, tool-wearing abrasives in the steel reduced and the smooth, bright machined surface improved. Because of the increase in machinability effected by furnace treatment, capacities for annealing, normalizing, spheroidizing, stress relieving and other heat treating have been expanded.

Whether you produce a complicated part like that at the left or one more simple in design, you need the improved machinability of Union Cold Drawn Steels to help you make better steel parts faster and at lower cost.

REPUBLIC STEEL CORPORATION
Union Drawn Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

Republic

REPUBLIC STEEL

DS

UNION COLD DRAWN STEELS

Reg. U. S. Pat. Off.

Free-Machining Bessemer, Open-Hearth and Electric Furnace Steels

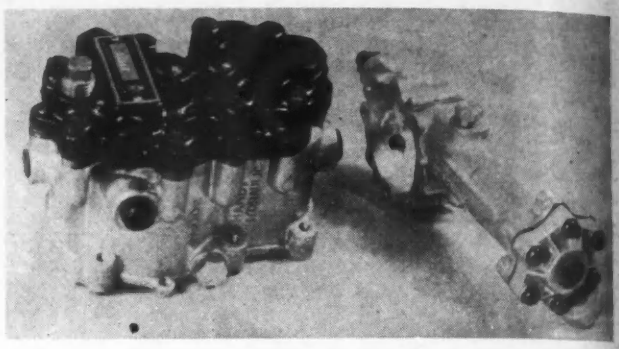
•

Union Cold Drawn Special Sections

•

Union Cold Drawn and Ground Rounds; Turned and Polished Rounds; and Turned, Ground and Polished Rounds (Union Precision Shafting)

Hydraulic Engine Governor



Handy hydraulic governor.

An innovation in engine governors for applications requiring accurate speed regulation is found in the Handy hydraulic governor recently announced by King-Seeley Corp., Ann Arbor, Mich.

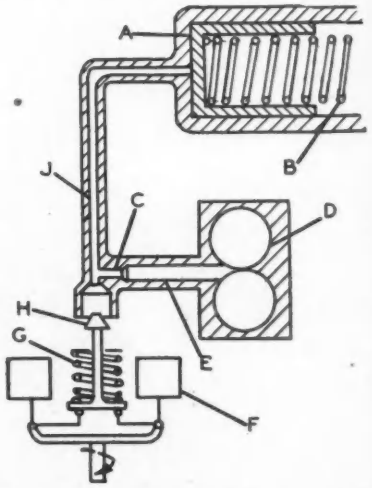
One of its principal features is that of universal installation where the standard master unit (weight system and pump) can be driven from any convenient take-off on the engine or transmission, either by direct mechanical connection or by belt and driven in either direction of rotation. Moreover, it can be assembled either in a horizontal or vertical position depending upon the disposition of the drive shaft. The slave cylinder can be connected either by a solid or flexible line to the master unit and can be mounted either on a separate sandwich type throttle body or directly on the carburetor.

Apart from facility of installation, this governor is produced as a standard interchangeable unit which can be applied to all engines in the line and for a practical engine operating range from 800 to 4000 rpm.

The principle of operation may be described by reference to the diagrammatic sketch. The weight system and pressure pump are actuated by a single drive from the engine take-off. Rotation of the pump, which is fed from the engine pressure system, develops fluid pressure in conduit A which is modulated by the release of fluid through a restriction orifice. Since the area of the annulus around the pressure control valve is greater than that of the restriction orifice, when the weights are in the inner position with the valve open, no pressure is registered in conduit B or against the slave piston. This is the situation at speeds below governed speed.

The slave piston is attached to the throttle lever. With the piston in the position shown, the throttle is wide open; as the piston moves toward the right, the throttle closes. When engine speed increases so that weight energy

(*Turn to page 66, please*)



Schematic Diagram of Operating Circuit for Handy Governor

A Slave piston, B Piston spring, C Restricting orifice. D Pressure pump, E Conduit "A", F Weight system, G Weight spring, H Pressure control valve, J Conduit "B"

Design engineers in industry were faced with the need to control pressures far in excess of normal limits.

Standard metal bellows, ideal for most pressures, just couldn't stand the gaff.

Fulton Sylphon application engineers, working closely with these customers, developed a product now wide and favorably known as the Sylphon Multi-ply bellows.

Multi-ply bellows consist of two, three and four metal tubes fitted closely together and then corrugated as a unit —just as standard bellows are corrugated. The result is extra strength . . . sufficient to withstand high pressures . . without excessive loss of flexibility.

Precision built by specialists with more than 40 years' experience, these multi-ply bellows . . . like all Fulton Sylphon products . . . are engineered to do their job better, longer, at less cost to you.

Why not find out today how they can be used profitably in your business? Catalog VB -1300, packed full of information and idea starters, is yours for the asking.

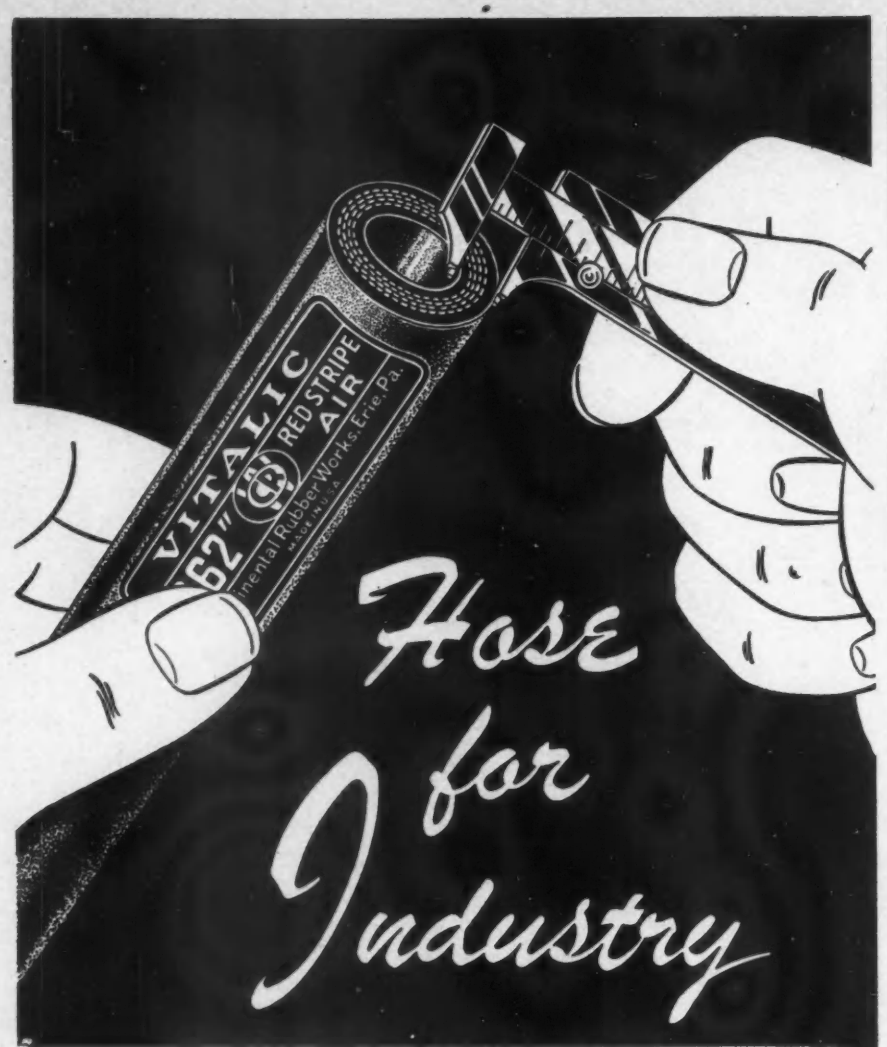
FS
FIRST WITH BELLOWS

FULTON SYLPHON

Temperature Controls • Bellows • Bellows Assemblies

THE FULTON SYLPHON COMPANY • KNOXVILLE 4, TENNESSEE

Canadian Representatives, Darling Brothers, Montreal



THE longer life you expect—and get—from Continental hose is the direct result of precision methods maintained in every step of the hose-building process. Remember that Continental are longtime specialists in hose design. It will pay you to check your hose requirements with your nearby Continental branch or write the factory direct.

BRANCHES

Baltimore, Md.	Dallas, Texas	Kansas City, Mo.	Philadelphia, Pa.
Boston, Mass.	Dayton, Ohio	Los Angeles, Cal.	Pittsburgh, Pa.
Buffalo, N. Y.	Detroit, Mich.	Lutz, Fla.	Rochester, N. Y.
Chicago, Ill.	Greensboro, N. C.	Memphis, Tenn.	St. Louis, Mo.
Cincinnati, Ohio	Hartford, Conn.	Milwaukee, Wis.	San Francisco, Cal.
Cleveland, Ohio	Indianapolis, Ind.	New York, N. Y.	Syracuse, N. Y.

★ *Continental also manufactures molded, extruded and lathe cut goods, as well as a complete line of packing and other industrial maintenance items.*

SEE OUR CATALOG IN SWEET'S

CONTINENTAL RUBBER WORKS
ERIE · PENNSYLVANIA · U. S. A.

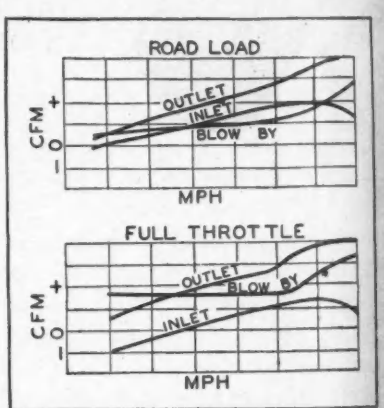
is sufficient to overcome the weight spring, the pressure control valve begins to move into its seat. As a result, it begins to reduce the flow of fluid around the valve and thus begins to raise the pressure against the slave piston. This is the point of cut-off from the full load engine power curve.

As the load on the engine is reduced, engine speed increases somewhat. This results in further closing of the valve and increasing the fluid pressure against the slave piston. The latter then moves against its resisting spring and thus closes the throttle. This is the "no-load" engine speed point.

Flowmeter Testing

(*Continued from page* 39)

achieved, the flows may be read directly by observing the floats in the two rotameters. If the flow through either side of the meter should be reversed, the reading would be below zero and could not be determined until the two-way valve is reversed. The resulting reading then would be reported as negative. In this way a measurement of the outlet and inlet flow is obtained. When both are positive (that is the flow is into the inlet and out the outlet of the engine) the difference is blow-by. If the inlet flow is negative, it is added to the outlet flow and the sum is blow-by, since the flow is out of the engine at both openings and no fresh air is being admitted. The amount of blow-by determined in this manner will check the amount found



Sample curves of crankcase ventilation.

when the flowmeter is used to measure only blow-by.

The sample curves shown illustrate the characteristic results that can be obtained with this device. Some of the other features noticed during tests were: pumping action of the engine on deceleration (negative blow-by—more flow into the inlet than out the outlet of the engine); the speed where blow-by starts a rapid increase due to piston ring flutter; and the relation of speed to load, or the variation in blow-by at various speeds with a head wind, without a wind, or with a following wind.

TINNERMAN NEWS EXTRA

CLEVELAND, NOVEMBER, 1946

76TH YEAR OF TINNERMAN PROGRESS

WEATHER
...ar with dimin-
...ing costs.

76TH YEAR OF TINNERMAN PROGRESS

BUYERS GET HOT TIP

MASS PRODUCTION OF NEW SERIES SPEED NUTS RESPONSIBLE FOR LOWEST PRICES IN HISTORY

Buyers Determine Savings by Checking Present Purchases of Threaded Nuts and Lock Washers

It is a simple matter to determine the savings made in the assembly of any product by converting to C7000 Series Speed Nuts.

Buyers are simply taking count of the number of threaded nuts and lock washers used daily on machine screws. For example, one manufacturer using 15,000 thread nuts and lock washers per day found that the total consumption exceeded 5 million a year. The annual net saving by conversion into a substantial figure. But conversion was made immediately. In addition to saving on the thousand, converting to Speed Nuts also gave the advantage of time saving. Speed Nuts are applied in reduced weight, it lowers portation charges and it eliminates the old problem of loosening.

Then too, in many assembly space is limited. A Speed Nut can be applied where the space is too small to apply threaded nuts and lock washers without costly wasting delays.

Even if the C7000 Series Speed Nuts cost more than threaded nut and lock washers, they would bring down the total net assembly cost. But with Speed Nuts the savings are still greater. Lower product using machine screws in sheet metal screws in any of the ten most popular sizes.

The C7000 Series Speed Nuts are accurately heat treated, given a rust resisting finish, have live action spring steel locking screw with a firm grip. Locking is fully prevented because the spring steel not absorbs the vibration which causes loosening in conventional threaded nuts.

Billions of Speed Nuts have proved their work on hundreds of mass production products for more than a decade. The time to cut costs is now. Every day's delay is money in savings otherwise effected.

NEW SPEED NUTS HAVE RUST-RESISTING FINISH

The corroding and rusting of ordinary threaded nuts presents a serious problem in connection with servicing and replacing parts, because the nuts must be chiseled or sawed off. Having no "freeze" to bolts or screws, Speed Nuts are easily removed.

Shrewd, alert, cost-conscious John Buyer, speaking today for American Industry, admitted wide affect of latest Tinnerman Announcement. He predicted that, "The new C7000 Series Speed Nuts, costing less than threaded nuts plus lock washers, will save hundreds of thousands of dollars, as well as give impetus to better and faster assembly of mass production products". From Cleveland comes word that large stocks are on hand for immediate delivery. Prices and samples of the new Speed Nuts can be had for the asking.

Speed Nuts may be used on porcelain enamel, glass or plastic assemblies *without danger of breakage*. They provide the spring tension necessary for tight assembly, yet are sufficiently resilient to prevent damage due to expansion and contraction, vibration or shock.

The *wide bearing surface* of the Speed Nut spreads the fastening load over a much greater area than does an ordinary threaded nut. Therefore, the use of separate spanner washers is unnecessary. Here again there's a saving in cost and assembly time.

Speed Nuts are *self-locking*, for their unique spring action provides a positive lock that prevents vibration loosening. Thus, the use of separate lock washers is completely eliminated. You save the cost of the washers and the time necessary to handle and install them.

SPEED NUTS ELIMINATE LOCK WASHERS

With the use of C7000 Speed Nuts, the lock washer is necessary and obsolete. The purpose of the lock washer is to supply a spring-tension between the threaded nut and the part. With the spring-tension incorporated in the Speed Nut, only one part is necessary instead of two. Only one part to purchase, only one part to handle. In addition to this, the Speed Nut affords a spring-tension that cannot be secured with a lock washer. The tighter over the nut. And Speed Nuts never chiseled or sawed off. There's no expensive delay in the assembly line because of nut damage, when Speed Nuts are used. For Speed Nuts provide a spring-tension resiliency sufficient to such a degree that porcelain enamel, glass or plastic parts do not chip.

Speed Nuts are also insurance against damage in transit. Your products are subject to severe vibration and shock while being packed, handled and shipped. Speed Nuts provide a resiliency that cushions and protects porcelain enamel and glass assemblies against damage.

Eliminating a lock washer not only cuts the number of parts in half but it also cuts the work in half. The Speed Nut also has a wider bearing surface. That feature also prevents distortion of the panel or part to which the nut holds.

When you cut down the amount of buying you reduce stocking problems and handling problems. You save on transportation charges and you have a nut that does a more satisfactory holding job.

Many times Speed Nuts themselves replace two parts, as hundreds of special fasteners to meet the requirements of out-of-the-ordinary applications, our Engineering Department is at your service at all times to help solve your fastening problems, and would welcome the opportunity to analyze your fastening requirements.

A changeover to the "Fastest Thing in Fastenings" will very definitely improve your product, speed up production and reduce your total net assembly costs.

Speed Nuts provide a double lock on bolt or screw to prevent vibration loosening. Their *line* lock and a spring thread spring action absorbs vibration, instead of merely resisting it, insuring a tight attachment for the life of the product.

Speed Nuts are attached *permanently* to the part. The nut always remains in position. The *wide spring tension locking power*. And Speed Nuts never have to be chiseled or sawed off, requiring a new nut for replacement.

There's no expensive delay on the assembly line because of product damage, when Speed Nuts are used. For Speed Nuts are self-locking by reason of resiliency which prevents tightening parts to such a degree that porcelain enamel, glass or plastic might crack or chip.

Speed Nuts are also insurance against damage in transit. Your products are subject to severe vibration and shock while being packed, handled and shipped. Speed Nuts provide a resiliency that cushions and protects porcelain enamel and glass assemblies against damage.

Speed Nuts are also used to compensate for misalignment of clearance holes. When ordinary threaded nuts are permanently attached to parts for blind assembly, the threads become clogged with paint. This makes it necessary to delay final assembly until the threads can be retapped. Having no threads, Speed Nuts *do not clog*.

The corroding and rusting of ordinary threaded nuts presents a serious problem in connection with servicing and replacing parts, because the nuts must be chiseled or sawed off. Having no threads, Speed Nuts will not "freeze" to bolts or screws, and are easily removed.

Greater Strength is Result of 20 Years of Engineering Experience

Back of the C7000 Series is all the experience of the Tinnerman factories and their extensive engineering and development departments. For more than 20 years the Tinnerman organization has devoted itself to studying and solving assembly problems. No other record of engineering development in this field.

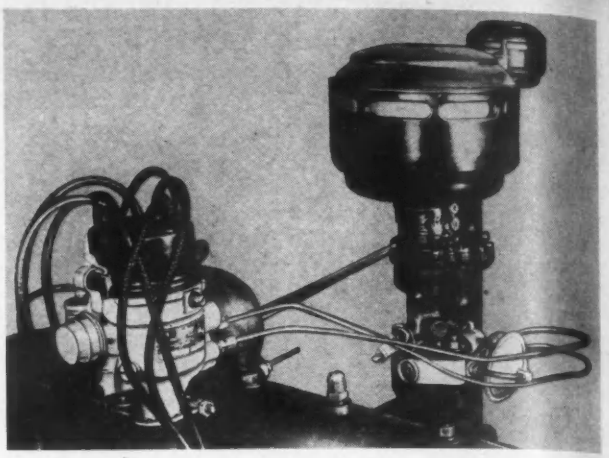
Speed Nuts

TINNERMAN PRODUCTS, INC. • 2059 FULTON ROAD • CLEVELAND 13, OHIO

Ignition Distributor and Engine Speed Governor

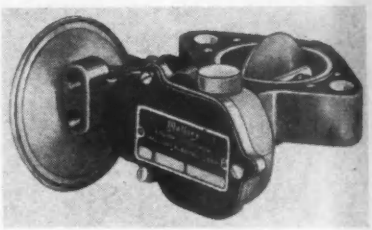
A combination ignition distributor and engine sped governor, combining the features of centrifugal force and manifold depression, was recently placed on the market by the Mallory Electric Corp., Detroit 4, Mich. Although the centrifugal control valve may be installed separately and driven from some convenient take-off, the maker claims that there are many advantages to the use of the combined distributor and governor layout.

Mallory Models ZG and YG distributors are built with a centrifugal valve mounted on the distributor shaft under the ignition governor. This serves as a control for the governor throttle box installed in a separate housing under the carburetor in the usual fashion. The Mallory throttle box is available in different sizes and in single or dual types, and is so designed that the governor throttle opens in the same direction as the carburetor throttle.



View of popular engine, showing Mallory distributor valve at the left connected by tubing lines to the throttle box under the carburetor at the right.

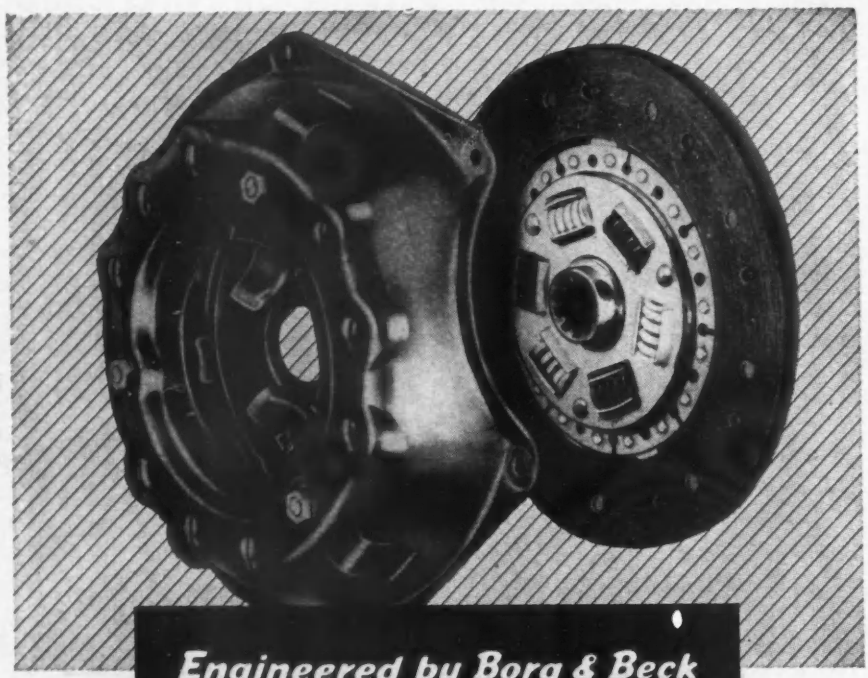
The operating principle may be summarized briefly as follows: The centrifugal valve, operated by light forces and moving not more than 0.050 in., tends to close the throttle valve by shutting off the orifice communicating with the passages to the diaphragm in the throttle box that actuates the throttle. This action, in turn, is opposed by vacuum force which tends to hold the valve open, thus providing a differential action of opposing forces. Governor action, therefore, in in direct relation to changes in manifold depression as well as changes in engine speed, and this is said to produce excellent speed control.



View of carburetor throttle box assembly. The operating diaphragm is mounted in the pressure housing at the extreme left and linked directly to the throttle.

The claim is made that this governor will control engine speed in a range from 1000 rpm to 3000 rpm or over without changing any parts, by making some simple adjustments.

For maximum economy the Mallory governor should be installed in combination with a carburetor that has a vacuum power jet in such position that it communicates directly with the circumferential groove in the throttle box flange. No mechanical connection is required between the ignition distributor housing and the throttle box, the only connection being a ¼-in. tube from the centrifugal valve outlet to the inlet at the throttle box.



Engineered by Borg & Beck
means... FINER BALANCE
SMOOTHER PERFORMANCE

You can depend on—

BORG & BECK
FOR THAT VITAL SPOT WHERE POWER TAKES HOLD OF THE LOAD!

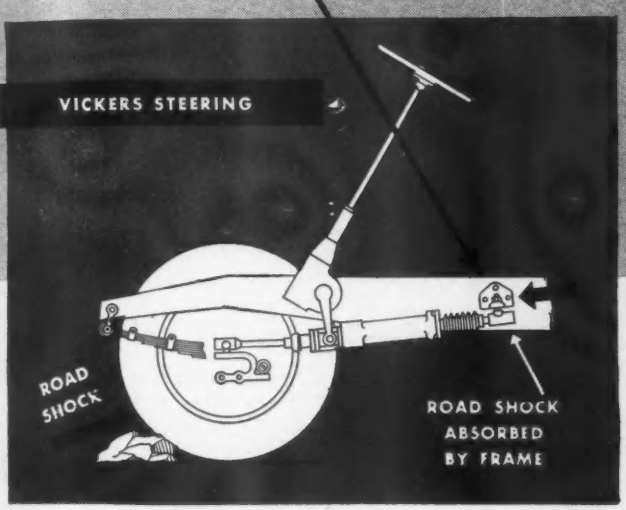
BORG & BECK DIVISION
BORG-WARNER CORPORATION
CHICAGO, ILLINOIS

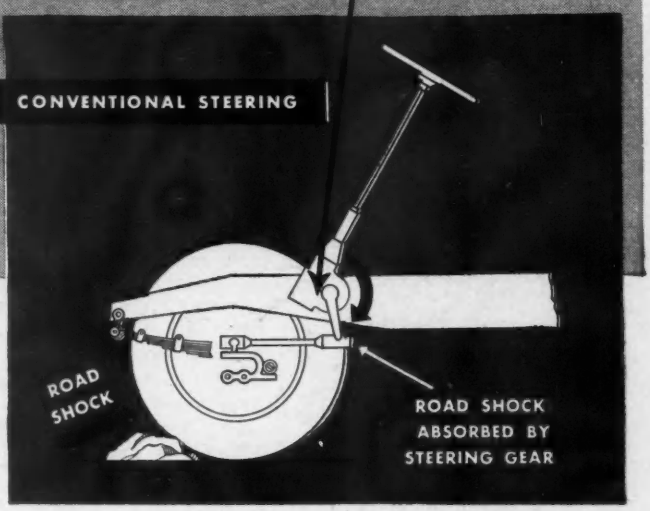
BORG & BECK CLUTCH — THE STANDARD

ENGINEERING BW PRODUCTION

VICKERS Hydraulic POWER STEERING

Transmits Road Shock Thrusts to the *FRAME... instead of to the Steering Gear*





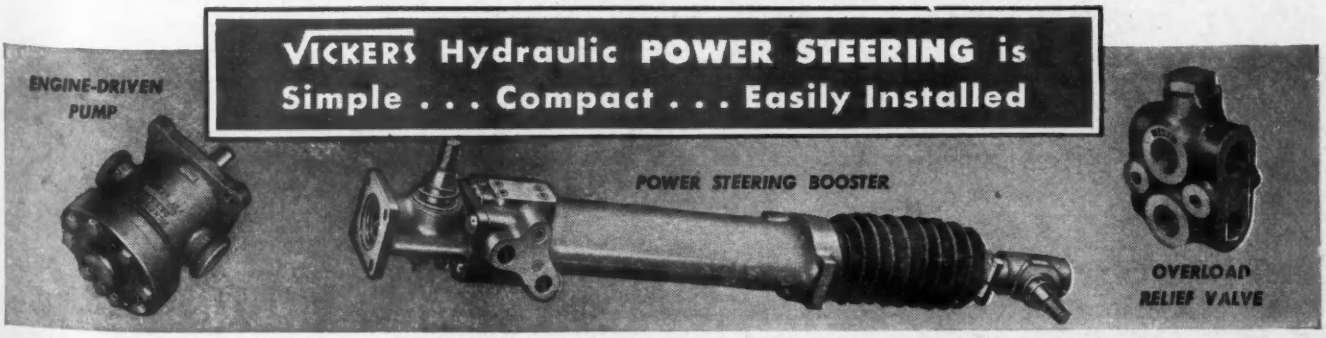
With Vickers Hydraulic Power Steering, no road shock can be transmitted to the steering gear and to the driver . . . road shock thrusts are transmitted to the frame. A vehicle can be driven over the curb, through sand, and on rough ground with no "fight" from the wheel. A flat tire will not cause swerving. A light touch on the steering wheel is sufficient at all times.

Among the many other important advantages of Vickers Hydraulic Power Steering are: greater driver efficiency by reducing fatigue to a minimum, easy application to existing chassis designs, automatic overload protection for both hydraulic system and steering linkage, and 15 years of successful operating experience on trucks, buses, road machinery, etc. Ask for Bulletin 44-30 which contains complete information about the Vickers Hydraulic Power Steering System.

VICKERS *Incorporated* **1428 OAKMAN BLVD. • DETROIT 32, MICH.**

Application Engineering Offices: **CHICAGO • CINCINNATI • CLEVELAND • DETROIT • LOS ANGELES • NEWARK PHILADELPHIA • ROCHESTER • ROCKFORD • TULSA • WORCESTER**

VICKERS Hydraulic POWER STEERING is Simple . . . Compact . . . Easily Installed



Civil Aircraft Shipments Classified by Total Rated Horsepower*

	1-74 Hp	75-99 Hp	100-399 Hp	400 and Over, Hp	Total
January	1,047	†	140	40	1,227
February	939	†	265	48	1,252
March	1,479	†	490	50	2,019
April	1,675	544	44	48	2,311
May	2,093	820	88	72	3,073
June	2,147	1,042	191	49	3,429
6 Months	9,380	2,406	1,218	307	13,311
July	1,915	1,076	366	31	3,388
August	2,622	1,363	670	28	4,683
September	2,185	1,059	754	42	4,040
9 Months	16,102	5,904	3,008	408	25,422

* Industry Division—Bureau of the Census.

Civil Aircraft Shipments by Number of Places*

	2 Place	3 and 4 Place	5 and More Places	Total
January	1,172	....	55†	1,227
February	1,180	....	72†	1,252
March	1,919	....	100†	2,019
April	2,219	44	48	2,311
May	2,921	80	72	3,073
June	3,202	178	49	3,429
6 Months	12,613	302	396	13,311
July	3,087	271	30	3,388
August	4,189	467	27	4,683
September	3,504	497	39	4,040
9 Months	23,393	1,537	492	25,422

†—Includes a few 3 and 4 place planes.
*—Industry Division—Bureau of the Census.

Civil Aircraft Shipments by Number of Engines

	1 Engine	2 and 4 Engines	Total Planes
January	1,187	40	1,227
February	1,204	48	1,252
March	1,969	50	2,019
April	2,263	48	2,311
May	3,001	72	3,073
June	3,381	48	3,429
6 Months	13,005	306	13,311
July	3,363	25	3,388
August	4,658	25	4,683
September	4,002	38	4,040
9 Months	25,028	394	25,422

Grizzly's more than 30 years manufacturing experience, constant laboratory research and alertness to new developments supply the "know-how" for successful solutions to countless brake lining problems of widely diversified natures.

Regardless of whether your problem is in the automotive or industrial field, Grizzly can be of assistance to you. Among production, engineering and purchasing men, Grizzly is recognized as one of the largest, most dependable producers of molded brake linings—added assurance that Grizzly has ample facilities to serve you.

Next time a brake lining problem confronts you, consult Grizzly.

GRIZZLY MANUFACTURING COMPANY
PAULDING, OHIO
PLANTS AT PAULDING AND BELL, CALIF.
Warehouse Stocks in Principal Cities

Aircraft Products

(*Continued from page* 48)

One inherent feature of this suspension balancer is its ability to be checked for accuracy at any time by simply rotating the balancer assembly 180 deg in the propeller which has just been brought in balance by this method.

Oil Drain Valve for Personal Planes

The Koehler Aircraft Products Co., 814 Vermont Ave., Dayton 4, Ohio, offers an improved oil drain valve for personal planes. This Koehler development provides rapid oil drainage, and at the same time eliminates the necessity of removing the plug from the oil sump every time oil is drained. The screw threads are safety wired when installed and from then on no further attention is necessary. The mechanism is approved by the CAA for installation in the oil sump of Continental engines on light planes. (*Illustrated on page* 48)

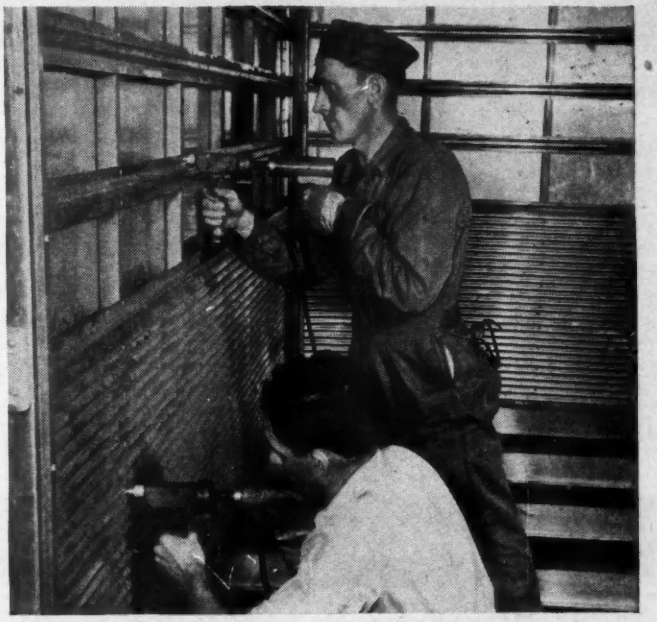
Aluminum Cleaner and Polish For Airplane Maintenance

R. M. Hollingshead Corp., Camden, N. J., has begun the marketing through its Aviation Chemicals Division of "Klad Polish," a specially formulated aluminum cleaner and polish for airplane maintenance.

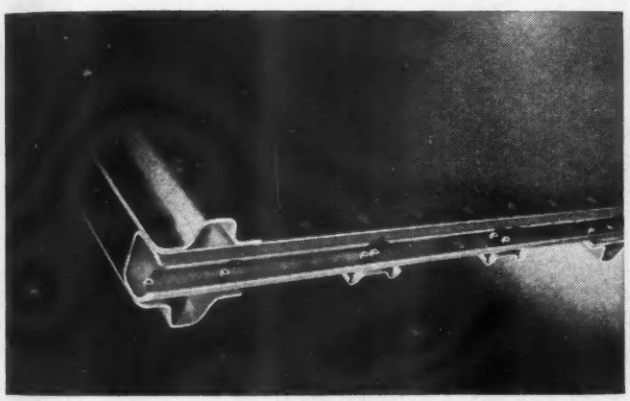
"Klad Polish" removes the dirt, grime and oxidation which make a plane dull and dingy, and in a single operation gives a glistening polish to the plane's aluminum surfaces. It is non-corrosive and non-inflammable.

How To Keep Costs Down

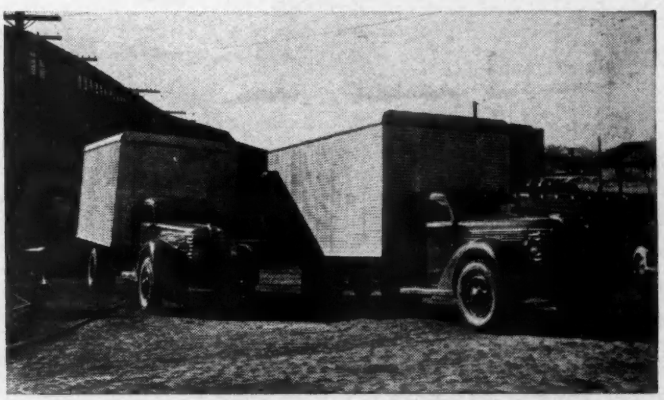
in constructing aluminum truck bodies...



Cross-members and aluminum panels are easily attached to the aluminum frame of the truck body. Note that the work is being done from one side.



Cut-away close-up shows how barrel-shaped shop heads of Explosive Rivet form strong, tight joints. Average of 15 Rivets are easily set per minute per man.



Completely assembled truck bodies. The Explosive Rivets have smooth manufactured heads requiring no after-finishing. Bodies are tight and strong.

In attaching aluminum side panels, roof panels and roof skins to the aluminum frame of truck bodies, the Reynolds Metals Company, Louisville, Ky., uses more than 2000 Du Pont Explosive Rivets in each body.

Here are the reasons why Explosive Rivets are used:

1. Explosive Rivets produce a strong, tight body. They do not tend to loosen under vibration.

2. Explosive Rivets reduce production man-hours because they are easily and quickly set.

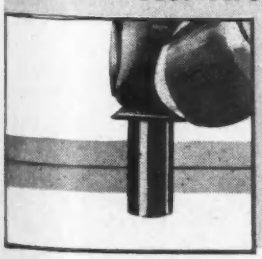
3. Explosive Rivets permit use of simple jigs and fixtures because they can be installed from one side.

4. Explosive Rivets simplify the entire assembling job and permit shipping truck bodies knocked down.

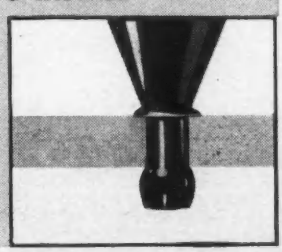
5. Explosive Rivets permit distributors in the field to readily assemble the truck bodies. These Rivets are quickly set with an electrically heated Du Pont Riveting Iron . . . eliminating need for elaborate equipment.

If you have a fastening problem, write us. We will help you determine how Explosive Rivets may save time and reduce production costs. Address E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington 98, Delaware.

JUST TWO SIMPLE STEPS TO INSTALL



1. Insert Explosive Rivet in the hole. 2. Apply tip of heated Du Pont Riveting Iron to Rivet head. In 1½ to 6 seconds the Rivet is set and a strong, tight joint is formed. It's a one-man job from start to finish.



DU PONT EXPLOSIVE RIVETS

A product of Du Pont Explosives Research

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

New Production Equipment

(*Continued from page* 46)

of a pneumatic counterbalance on each unit. This duplicates the profile of the hardened steel plate cam.

The tool holders carry multiple cutters which allow for fast feeds on boring operations.

At the completion of the machining cycle, the tool spindles are withdrawn clear of the work and rotation of tool spindles stopped, thus giving maximum protection to operator for loading and unloading.

The mating gear cover is run over the same machine after changing tools and work holding fixtures. Both fixtures are located on the welded steel bed by means of a hardened key and insert, thus assuring a rapid means of change-over.

JAS. H. MATTHEWS & CO., 2535 Forbes Field, Pittsburgh 13, Pa., offers a machine for marking delicate or precision parts having ground or polished surfaces that should not be marred or distorted. By means of a short blast of fine grit against rubber or celluloid stencil masks, upon which the part to be marked is placed, the result is a light, clear-cut, non-liquid impression without any burred surface. Suitable fixtures are made to hold parts so that they can be quickly handled by the operator.

Matthews Airgrit

The unit, named the "Airgrit," is operated by air pressure, and is constructed for very fine work. It operates most successfully on a volume of air at low pressure, about 10 lb. at the nozzle. The regular plant air line is used with a reducing valve and gauge installed between the line and the unit, so that the required 10 lb. of air pressure is available at the nozzle. An air filter or oil separator should be connected between the reducing valve and unit so as to absorb the moisture that may be present in the line due to condensation. This will keep the air clean and dry as it enters the unit. For best impressions, Matthews No. 180 Grit is recommended, and five lb. is included with each unit.

The Airgrit is also equipped with an electric timing unit, which enables the operator to fix the length of blast, so that parts may be marked uniformly.

A FLAT conveyor type, spray washing machine, adaptable for cleaning and similar spray operations, as well as for drying, has been introduced by the Optimus Equipment Co., 269 Church Street, Matawan, N. J., manufacturers of metal washing and drying equipment. The new machine will rapidly spray any parts which may be handled either in baskets, on racks, or simply laid on the conveyor.

The manufacturer states this type of conveyor can be adapted to many different problems. Special parts can be positioned if necessary, and little labor is required for loading or servicing.

Alkaline, acid, solvent type, air dry-

(*Turn to page* 74, *please*)

FLOOR MAINTENANCE MADE EASY

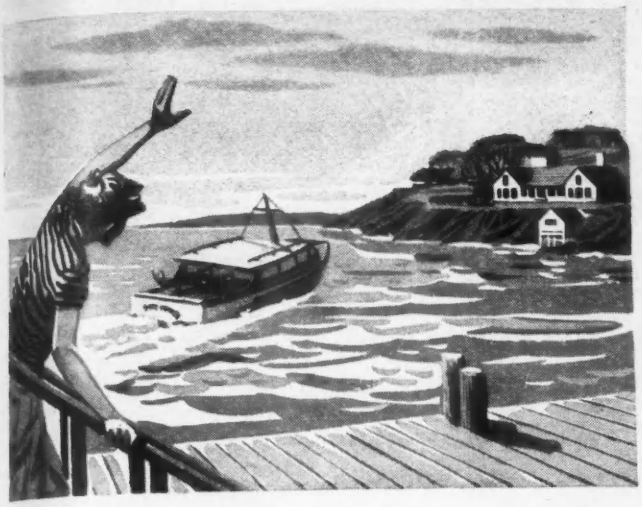
Floor maintenance jobs are easy—when Triad GF is used. Floor brilliancy is assured with every application!

Triad GF makes light work of removing heavy grease and oil that mar floor appearance in and around garages, hangars, runways and buildings. Its low alkalinity and high wetting ability produces chemical scrubbing action.

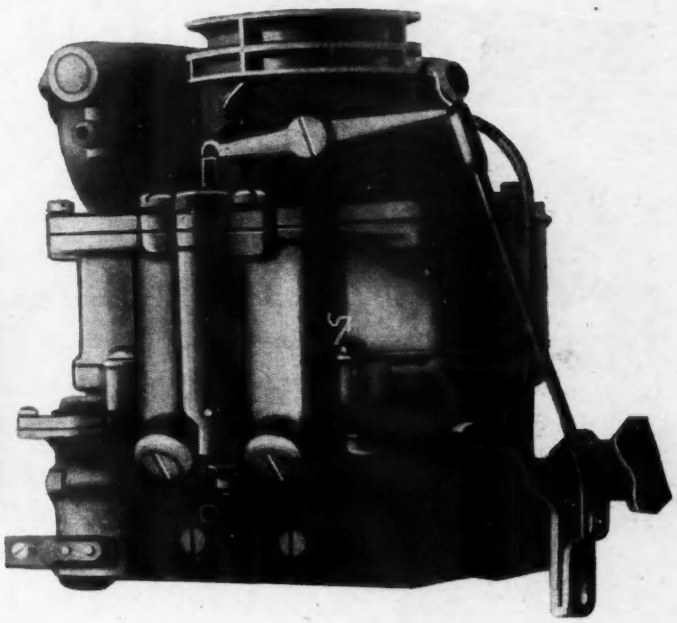
It is packaged for economy. Buy a 120-lb. supply in a metal container at a bulk price. Use TRIAD GF for BETTER floor maintenance—at a lower cost.

Call our local office or write direct to Detroit for information on any cleaning requirement.

DETREX Corporation
DETROIT 32, MICHIGAN
A-142



wherever gasoline goes



STROMBERG*

stands out

for reliable carburetion

ECLIPSE MACHINE DIVISION of Bendix Aviation Corporation • Elmira, N. Y.

*REG. U. S. PAT. OFF.

PRODUCT OF Bendix AVIATION CORPORATION

Better Grinding

★ Greater Production

★ Finer Finish

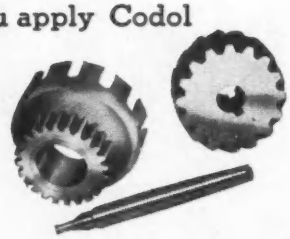
★ Longer Wheel Life

...by the barrel

CODOL Liquid Grinding Compound has often proved to be the primary factor in turning an unacceptable performance into a complete success. One user says: "When Codol replaced another fluid for grinding a crankshaft, wheel life jumped from 14 to 20 pieces and gumming disappeared." Says another: "Of seven compounds tested, Codol produced the best finish." And another: "Since standardizing on Codol for surface grinding, wheel and segment life has improved and rusting has been eliminated."

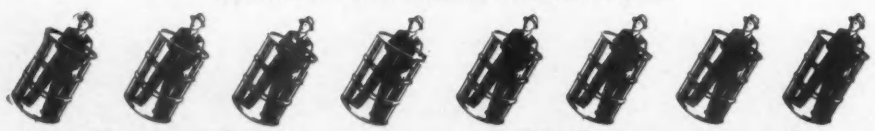
A Stuart Engineer will help you apply Codol to your advantage, whatever your grinding problems may be. Ask him to visit you.

Write for "Up-to-Date Grinding Practice"

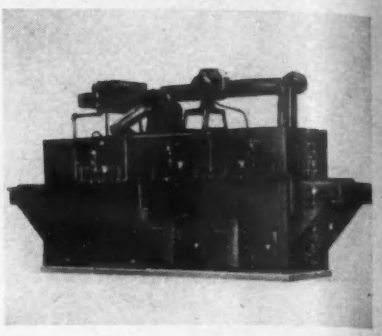


D.A. Stuart Oil Co. LIMITED
EST. 1865

2733 SOUTH TROY STREET, CHICAGO 23, ILL.



Stuart Oil Engineering Goes With Every Barrel



Optimus flat conveyor-type spray washing machine

ing, oil spray, and similar operations can all be handled. Any type of heating can be employed, and the machine is available in all sizes with any variety of horizontal conveyor.

The machine features a long horizontal tunnel placed on top of a series of solution tanks. A continuous flat conveyor runs the length of the tunnel, carrying parts through a series of operations.

Solutions are forced on the parts through a battery of spray nozzles by means of a powerful pump. The machine is self-contained, but it may be connected to any other conveyor-moved operation, thus reducing parts handling to a minimum.

MOORE PRODUCTS Co., H & Lycoming Sts., Philadelphia 24, Pa., announces a new type of air-gaging member for use with the Moore pneumatic comparator gage. This V-block-type pneumatic unit may be supplied for simultaneous measurement of one, two, or more outside diameters as small as 0.150 in. or as large as 8 in. The instrument which is illustrated measures two diameters on the pinion shaft and is used for selecting parts within 0.00005 in. Rotating the part in the gage checks out-of-round, and sliding the part axially checks taper.

The weight of the part is carried on tungsten carbide wear strips, so that the V-block-type unit is practically un-

(*Turn to page 76, please*)

Moore pneumatic comparator gage

MICHIGAN WELDED STEEL TUBING

ROUND, SQUARE, RECTANGULAR AND SPECIAL SHAPES

- *IN COMMERCIAL LENGTH*
- *CUT TO SPECIAL LENGTHS*

SQUARE	ROUND	RECTANGULAR
½" to 2¾" 14 to 20 gauge	¼" to 4" O. D. 9 to 22 gauge	½" to 2¾" 14 to 20 gauge

Adaptability!

Michigan Welded Steel Tubing is available in sizes and shapes that make it readily usable in the production of a wide variety of parts.

Whether you form and machine the parts in your plant or order them prefabricated by Michigan, you will find this tubing exceptionally uniform in structure and adapted to reworking by any production process. Michigan welded tubing can be:

Engineering advice and technical help in the selection of tubing best suited to your needs. Address your inquiries to:

Michigan STEEL TUBE *PRODUCTS CO.*

More Than 25 Years in the Business

9450 BUFFALO STREET • DETROIT 12, MICHIGAN

FACTORIES: DETROIT, MICHIGAN • SHELBY, OHIO

DISTRIBUTORS: Steel Sales Corp., Detroit, Chicago, St. Louis, Milwaukee and Minneapolis—Miller Steel Co., Inc., Hillside, N. J.—C. L. Hyland-Dayton, Ohio—Dirks & Company, Portland, Oregon—James J. Shannon, Milton, Mass.—Service Steel Co., Los Angeles, Calif.—American Tubular & Steel Products Co., Pittsburgh, Pa.—Strong, Carlisle & Hammond Co., Cleveland, Ohio—C. A. Russell, Inc., Houston, Texas—Drummond, McCall & Co., Ltd., Toronto, Canada.

affected by wear. The nozzles which perform the measuring are recessed below the surface. Dirt, oil, and coolant on the work have no affect on the accuracy of measurement. This gage can, therefore, be installed right at the grinding machine.

The gage is equipped with the Moore adjustable compensator. This permits positioning the magnification on standard calibrated dials with interchangeable gaging members of various types and sizes.

Colmonoy Spraywelder

THE COLMONOY SPRAYWELDER, a new type of powder metallizing unit, is now in production at Wall Colmonoy Corp., Detroit, Mich.

The Spraywelder was developed for use in conjunction with the Colmonoy Sprayweld process. With this new unit it is said to be possible to combine the advantages of both welding and metalizing procedure. The unit is operated in the first part of the process as a powder metalizing unit to apply a uniform overlay of the Colmonoy alloy. It is then used as a conventional welding torch to fuse this sprayed overlay to the base metal to obtain a fusion or molecular bond, identical to that obtained when the same alloy in rod form is applied by acetylene welding.

There are only two control valves, both mounted on the gun itself. Once adjusted, the powder flow may be stopped and started at will by pressing or releasing the trigger. The gun may be hand operated, or held in a vise or with an attachment in the tool post of a lathe.

While the unit was primarily designed for spraying Colmonoy alloys, it will handle other powdered compositions.

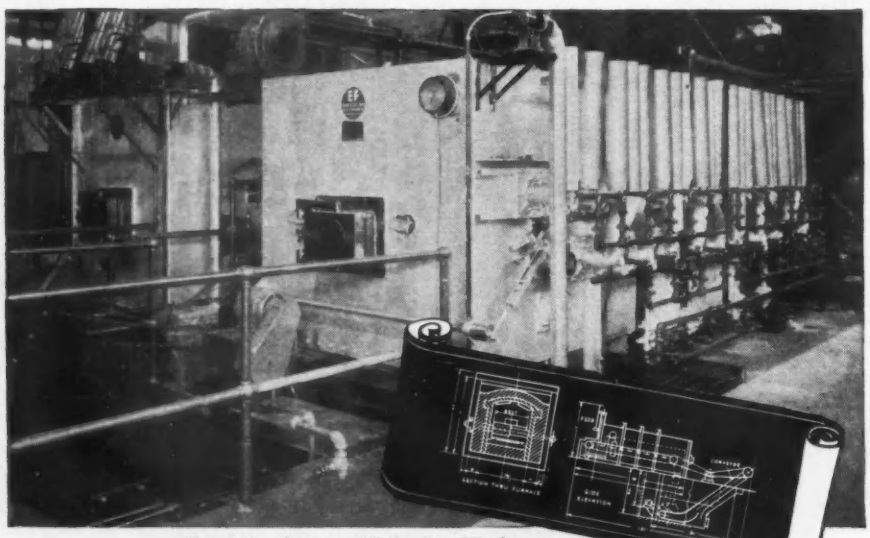


Illustration shows an EF Gas-Fired Radiant Tube Furnace; Diagram Shows an EF Electric Furnace

CONTINUOUS SMALL PARTS HARDENING

Capacities from 175 to 2000 lbs. per hour

● EF CONTINUOUS CHAIN BELT CONVEYOR TYPE FURNACES are unexcelled for the low cost, continuous heat treatment of small and medium sized parts. The material to be treated is loaded directly onto the cast link heat resisting belt, is carried into the furnace automatically, uniformly heated to the proper temperature, quenched and discharged. These furnaces are available in gas fired, oil fired and electric types in 11 standard sizes. Each is readily adapted for use with special atmospheres, for heat treating without scaling or decarburization. But send for Bulletin No. R-1—"Chain Belt Conveyor Furnaces"—it gives full details—and let EF engineers work with you on your next heat treating job.

THE ELECTRIC FURNACE CO.

GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION

Salem-Ohio

GRAND SPECIALTIES CO., 3113 W. Grand Ave., Chicago 22, Ill., has brought out a new quick-action, heavy-duty vise. Known as the Grand Vise Master, this general utility speed vise is claimed to incorporate advantages not found in conventional types of machinists' vises. The new vise

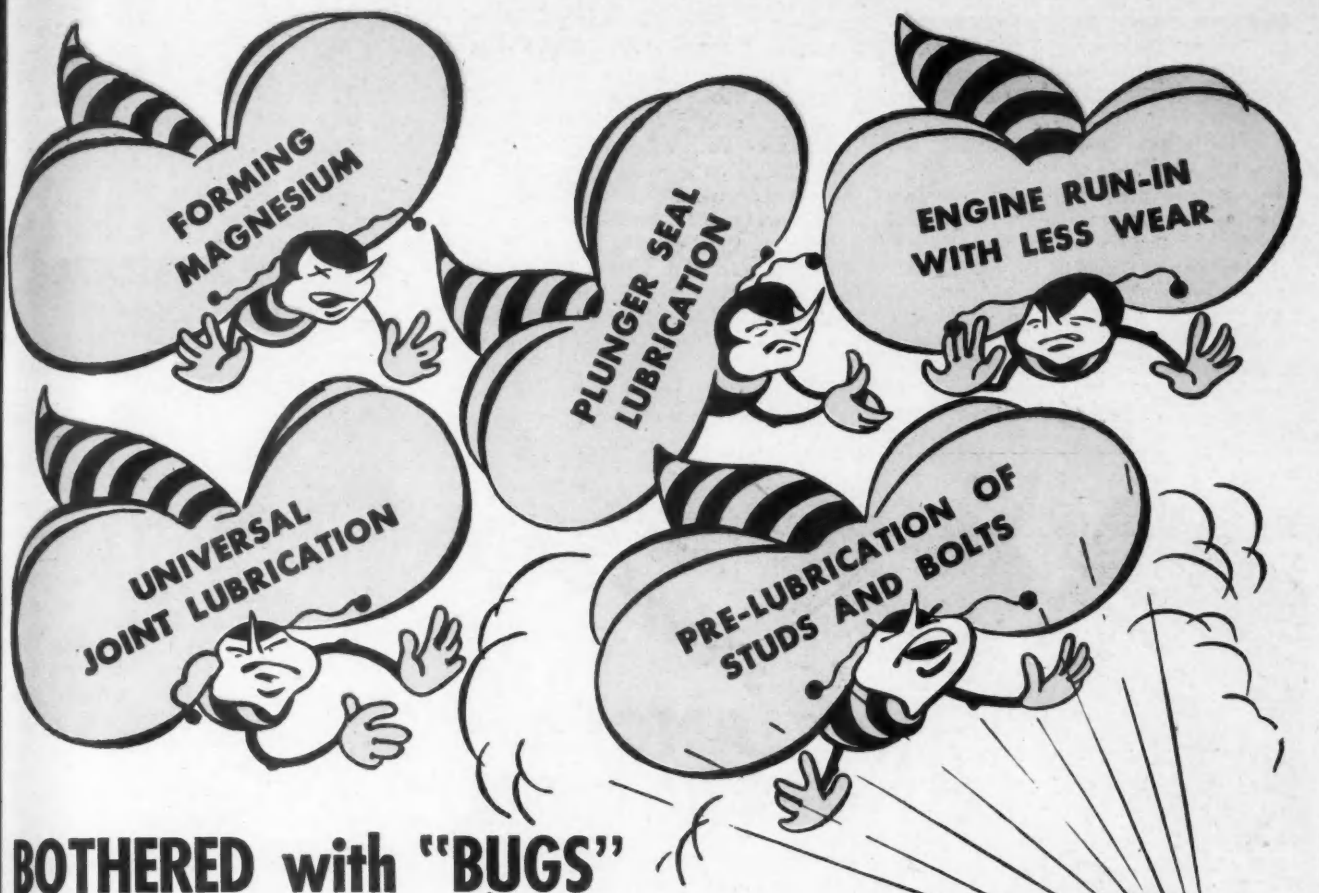
Grand Vise Master

Master is described as closing instantly with a push on the free jaw, eliminating the time and motion required for running in with handle, and opening automatically by trigger release on its spring action, features previously found only in the smaller Quikcet vise manufactured by the same company.

In addition, this heavy duty speed vise is equipped with "Double Bite" steel pipe jaws which are integral with the body to eliminate time required to adjust loose jaws to pipe or tubing. The "Double Bite" is said to be an exclusive feature consisting of double pipe jaws in back to prevent "whipping."

A NEW rough boring tool has recently been added to the line of tools manufactured by Madison Manufacturing Co., Muskegon, Mich. This boring tool differs from conventional types in that the cutting blades are not inserted into a block. Rather, the blades them-

(*Turn to page 78, please*)



BOTHERED with "BUGS" like these?

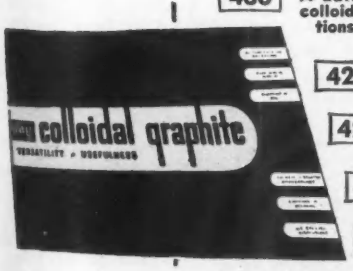
The picture shows the cure: "dag" colloidal graphite. But it doesn't show *all* the "bugs" that versatile "dag" dispersions can put to sleep for good.

That's why Acheson Colloids experts have prepared the comprehensive line of free booklets shown below: to describe the 18 "dag" colloidal graphite dispersions (in water, oils, alcohols and special liquids), and to give to users a complete list of profitable applications in their *own* industries.

Are *you* up-to-date on "dag" dispersions?

ACHESON COLLOIDS CORPORATION, Port Huron, Michigan

This new literature on "dag" colloidal graphite is yours for the asking:



- 460 — A data and reference booklet regarding "dag" colloidal graphite dispersions and their applications. 16 pages profusely illustrated. ☐
- 421 — Facts about "dag" colloidal graphite for ASSEMBLING AND RUNNING-IN ENGINES AND MACHINERY. ☐
- 422 — Facts about "dag" colloidal graphite as a PARTING COMPOUND. ☐
- 423 — Facts about "dag" colloidal graphite as a HIGHTEMPERATURE LUBRICANT. ☐
- 431 — Facts about "dag" colloidal graphite for IMPREGNATION AND SURFACE COATINGS. ☐
- 432 — Facts about "dag" colloidal graphite in the FIELD OF ELECTRONICS. ☐

ACHESON COLLOIDS CORPORATION
PORT HURON, MICHIGAN DEPT. LL-1

JMLcoALL-1

Please send me without obligation, a copy of each of the bulletins checked.

NAME_____

POSITION_____

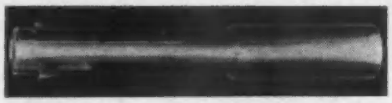
FIRM_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

OUR PRESENT OIL SUPPLIER IS_____

(Lubricants containing "dag" colloidal graphite are available from major oil companies.)



Madison rough boring tool

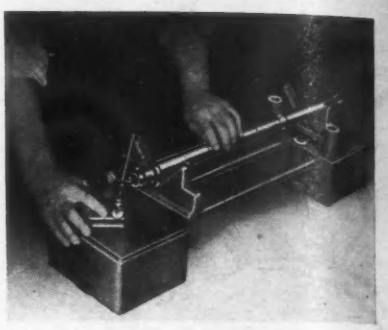
selves form the cutting block. A few of the advantages claimed for the new tool are quick changing of cutters, adjustment of cutter size before mounting in bar, and positive centering of cutter in bar. The Madison locating feature automatically centers the cutter, equalizing the load on the cutting elements.

A single micrometer thread screw expands both blades equally from the centering slot on the blades themselves.

THE SWANSON V-LINER, manufactured by Swan Tool & Machine Products, Inc., Erie, Pa., was developed in the Swanson shops to simplify concentricity checking on a miscellaneous variety of close tolerance machine parts. At the present, the V-Liner is available in the Model A size, which can handle diameters varying from ¼ in. to 6 in. in diameter, and from 1 in. to 24 in. in length. Models with the same diameter range are also available for handling parts up to 36 in. and 48 in. in length.

The V-Liner automatically determines the proper center line heights required for any combination of diameters involved in a work piece. This is accomplished by turning a properly compensated screw which raises the vertically adjustable V block on the instrument.

The instrument consists of two V blocks mounted on solid members which

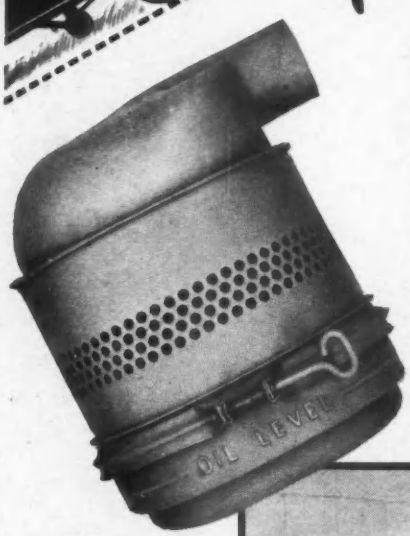


Swanson V-Liner

are held in correct alignment by cylindrical rods. These hardened and ground aligning rods are pressed into the first V block member and permit the second V block member with elevating V block to move as desired.

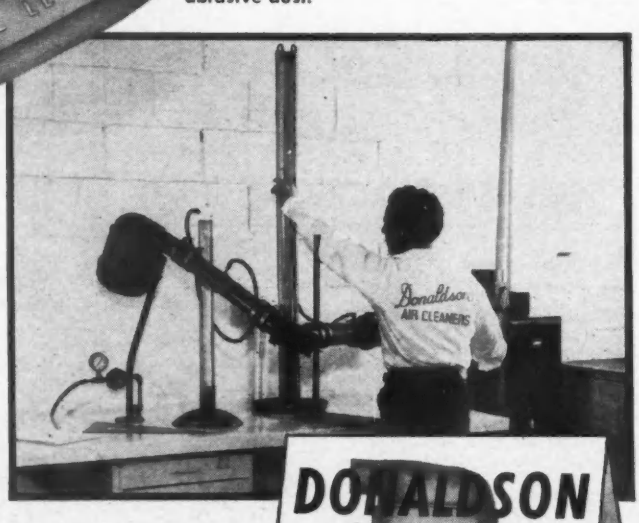
Both V blocks have replaceable hardened and ground tool steel wear edges. The hardened adjusting screw and bronze nut, which raises or lowers the movable V on guide pins, is calibrated and compensated for the sine of the V.

A new slant on ANGLE OPERATION



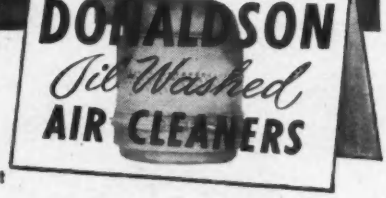
Over the road trucks and busses have their ups and downs too . . . on hills that is. During every climb and descent, certain changes occur inside the air cleaner, particularly a shift in the oil level.

To make certain of dust removal efficiency regardless of operating angle, Donaldson engineers run extensive tests like the one shown below, with the cleaner mounted at every angle which might be encountered in actual operation. These tests show that even when tilted as much as 30° Donaldson Cleaners maintain a dirt removal efficiency close to 100%. When you equip your engines with Donaldson Oil-Washed Air Cleaners, you are assured of *proved protection* against abrasive dust.



ANGLE TEST FOR OIL PULL-OVER
With air cleaner tilted to maximum angle which might be encountered in the field, pump simulates actual engine air demand. Technician checks observation window in outlet for evidence of oil pull-over.

DONALDSON CO. INC.
666 PELHAM BLVD.
ST. PAUL 4, MINN.
SALES ENGINEERS: Chicago Cleveland Detroit



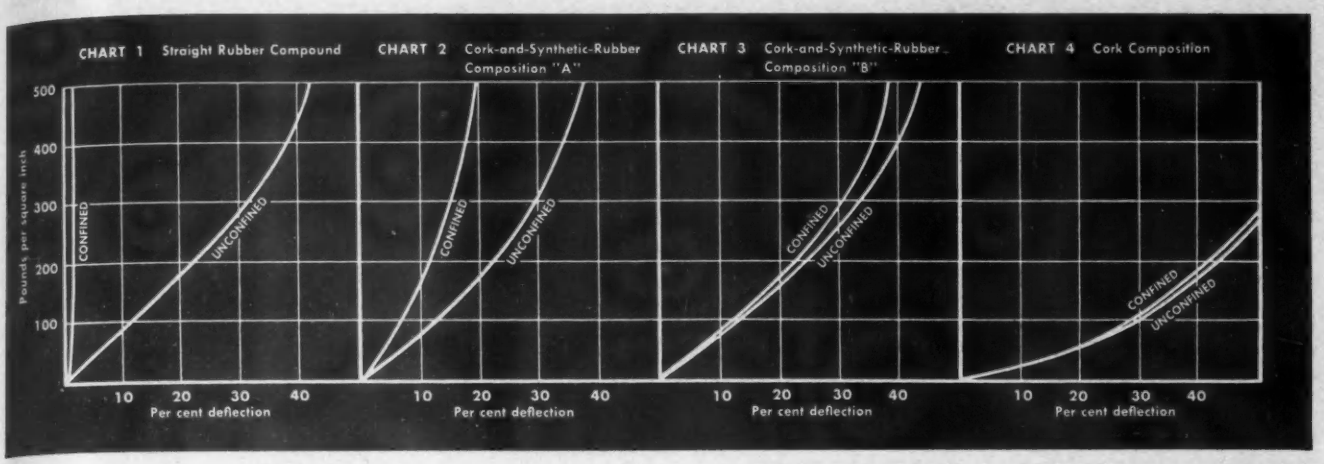
News of the Industry

(*Continued from page* 52)

broadcasting, alcoholic beverages, and wearing apparel, and that the same report shows a decrease in reported profits for iron and steel, industrial machinery, motor vehicle parts and accessories, electrical machinery, and other metal-working trades. Neither are they likely to point out that in the manufacturing field about half the employees received wage increases of from 5 to 18 cents an hour since V-J day, 23.4 per cent received 18 to 25 cents an hour more, and 24 per cent got no raise at all or less than 5 cents an hour. In non-manufacturing, on the other hand, nearly half received no pay increase, and another 30 per cent were boosted less than 10 cents an hour. As a result, Rising pointed out, the limited number of persons in the favored group could not purchase "mass volume" of the goods they produce, and the greater part of the unfavored "mass purchasing" market can't afford to pay the high prices stemming from higher labor costs.

Worldwide Decline in Vehicle Registrations

Today only 19 of every 100 motor vehicles previously registered in one war-torn European country are still running, according to the Automobile Manufacturers Association.



SEALING WITH CONFINED RESILIENT GASKETS

Control of compressibility and side flow is essential to a satisfactory seal

When design considerations make it necessary to confine a resilient gasket in a channel, it is desirable to have: (1) metal-to-metal contact of the sealed parts; (2) correct compression of the sealing medium; and (3) complete filling of the gasket channel. To accomplish all three, a sealing material is required in which both compressibility and side flow are controlled.

A non-compressible material like straight rubber will not meet the three conditions outlined above unless a relief is provided for side flow, or uneconomical tolerances are held in both gaskets and metal parts. Without such measures, the rubber may either overflow the gasket channel and prevent mating of the parts or fail to fill the channel sufficiently to insure a tight seal.

Another disadvantage of straight rubber in confined applications is that its deflection under pressure varies so widely. The shape, width, and thickness of a piece directly affect its behavior. Typical confined and unconfined compression curves for a straight rubber compound are shown in Chart 1.

A fully compressible material like cork composition has no such variables. Regardless of its shape, width, or thickness, deflection is the same and displacement occurs only in the direction of the applied load. There is no side flow whatever.

Where the properties of cork are indicated, cork composition is excellent for confined applications. It can be cut to full channel width and up to twice channel depth. Yet it will compress fully and permit perfectly mated metal-to-metal assembly. Chart 4 shows its behavior to be almost identical whether confined or unconfined.

Where the properties of synthetic rubber are needed, similar results can be had with one of Armstrong's cork-and-synthetic-rubber compositions. Combining calculated amounts of rubber and cork, these compositions offer predetermined degrees of compressibility and flow. Load-compression characteristics of two such materials are shown in Charts 2 and 3.

In the first cork-and-rubber material, Chart 2, a relatively small amount of cork has been used. While some compressibility has been gained, considerable side flow remains. This composition, therefore, leans toward the rubbery characteristics shown in Chart 1, with a marked difference in deflection between confined and unconfined specimens.

The second material, Chart 3, has a high cork content. Its characteristics, therefore, are more like those given for cork composition in Chart 4. Side flow is negligible and compressibility approaches its maximum. Behavior in confined and unconfined states is almost identical. Other Armstrong cork-and-synthetic-rubber compositions provide intermediate degrees of compressibility and flow.

Since minor design details often exert great influence on the choice of a sealing material, we suggest that you discuss your particular problem with an Armstrong representative before you set up specifications. He will suggest a material offering the right combination of properties for your application and provide samples for testing. If you prefer, send working drawings and details to us. We'll gladly analyze your problem and recommend a suitable material.

SEND FOR FREE BOOKLET.
For specification and application data on Armstrong's more than 50 resilient sealing materials, send for a free copy of the latest edition of "Gaskets, Packings, and Seals," twelve pages of helpful information. Address Armstrong Cork Company, Gaskets and Packings Department, 1511 Arch Street, Lancaster, Pennsylvania.

ARMSTRONG'S
GASKETS · SEALS · PACKINGS

Cork Compositions • Cork-and-Synthetic-Rubber Compositions
Synthetic Rubber Compounds • Cork-and-Rubber Compositions
Fiber Sheet Packings • Rag Felt Papers • Natural Cork

Looking Forward to Future Automobile Engines

(*Continued from page* 37)

having its own series of shadows in the form of resonating vibrations due to the restoring forces some of which will remain undamped.

A poor engine might be likened unto a poor sounding orchestra. It can be corrected by adding instruments to balance, or we can mute the dissonant elements, or we can reconstruct the orchestra. It surely would be better to deal with the possible disturbers by predetermining these trouble makers and dealing with them before putting the orchestra together in the first place. Rigid construction is an important offset to roughness, be the effect audible or not, since the moving units or walls move twice as far in return as the original direct displacement and are likewise quickly affected by minimizing the original deflection.

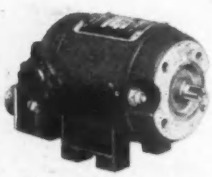
We have outlined a means of controlling the original force which is the pressure rise in the combustion chamber. We have called attention to the fact that detonation, although undesirable, is not an element which deflects the engine parts. Fig. 7 is a rate of pressure indicator card which shows the disturbance characteristics of main pressure and detonation. Here we see that detonation occurs well after the main disturbance occurs and that the detonation waves although lasting quite a while seldom get past the neutral line. At this time deflected parts are preparing to move back and detonation pressure wave can only somewhat dampen their movement but not add to it. It does not do either.

Since there is movement there are bound to be several synchronous weddings and consideration must be given to the parts which by design can economically be improved to put synchronization out of the driving range.

If we could increase the weight of our piston assembly we could modify the pressure rise effect. However, we would overload the bearings at other than the power stroke and soon the bending due to inertia would take charge. The period would be changed but not enough and the overall effect would be uneconomic. However, this does point up the undesirability of making the reciprocating forces too small. The present types of aluminum pistons with their present proportions of rings, pins and structures certainly can be considered as a desirable minimum. This consideration does make room for aluminum pistons with reinforcings of iron and steel. The small additional weight may be desirable. Light weight or thin wall iron pistons may represent the maximum in weight. The main point here is that minimum weight is not a must.

THE MARK OF MOTOR DEPENDABILITY...

Lamb Electric MOTOR



Compactly designed motor developed for metering pump and special instrument service.

Heavy-duty universal motor with in-built spur gear reduction.

Exacting manufacture backed by *thorough engineering* gives Lamb Electric Motors the long, trouble-free operation imperative for satisfactory product performance. Because of this standard of dependability, Lamb Electric Motors are being used in more and more of America's finest products.

THE LAMB ELECTRIC COMPANY
KENT, OHIO

Lamb Electric
FORMERLY Black & Decker Electric
SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS

Air Briefs

(*Continued from page* 33)

This provides suction for removing a part of the boundary layer on the retreating blade, thereby preventing its stalling and providing adequate lift over an extremely wide range of angles. In this particular design, the venturi on each tip are inter-connected in such a manner that the suction of the advancing venturi is applied to the retreating blade. The boundary layer is sucked through a slot located about ⅔ chord from the leading edge.

This new helicopter design has made 25 successful flights and tests are continuing. It is a two-place design powered by a Franklin 130 hp engine. Its construction was subsidized by the American Tool and Die Co., Reading, Pa.

All Clear AFTER 9,000 HOURS

SUN DIESEL LUBRICANT...

Keeps Rings Free in Big Diesels for More than One Year of Continuous Operation

More than a year of continuous running, day and night . . . no stuck rings . . . no heavy sludge . . . no hard carbon . . . that's the record of a "Job-Proved" Sun Diesel lubricant in a big industrial power house.

The picture above shows a piston from one of the company's two 750-h.p., 6-cylinder, 4-cycle, Worthington Diesels after 9,000 hours of operation. The engine was shut down at this time only for routine inspection.

Performance like this is typical of the results being obtained by hundreds of Diesel operators in plants throughout the country, and in all types and sizes of Diesel.

Sun Diesel Lubricants have proved their ability on the job. They have extremely high resistance to heat, with minimum tendency to form gum or hard carbon. For continuous power output and low maintenance costs, call the Sun office near you today.

SUN OIL COMPANY • *Philadelphia 3, Pa.*

Sponsors of the Sunoco News-Voice of the Air — Lowell Thomas

SUN

SUNOCO

INDUSTRIAL PRODUCTS

IF YOU WANT TO SHOW
Pleasing
Profits
Mechanize your material handling operations and stop worrying about price increases.
You can *insure* your profit position by converting your unskilled labor into skilled labor and achieve mass production at low cost.
CLARK TRUCTRACTOR conducts surveys of material movements and recommends new methods and means to reduce production costs.
A copy of Clark's "Material Handling News" is yours for the asking.
Plan to visit our exhibit, National Material Handling Exposition, Cleveland, January 14 to 17, 1947.
1000 TO 7000 LB. LOADS
CLARK
CLARK TRUCTRACTOR
Division of CLARK EQUIPMENT COMPANY
BATTLE CREEK, MICHIGAN
OTHER PLANTS — BUCHANAN, JACKSON, BERRIEN SPRINGS, MICHIGAN
Other CLARK Products
FORK LIFT TRUCKS
TOWING TRACTORS
TRANSMISSIONS
DUMP & SHOVEL TRACTORS
AXLES AND HOUSINGS
RAILWAY TRUCKS
DRILLS & GEARS
METAL SPOKE WHEELS
ELECTRIC STEEL CASTINGS
Prices on CLARK products will not be advanced in excess of increased costs.

Wage Incentive Plan for Group Effort

(*Continued from page* 17)

ployes of the decision, and outlined the reasons for it, including a recent strike which had forced cancellation of extensive expansion plans. He then informed them that one chance to keep the fabrication department going remained—the introduction of some kind of incentive system to be worked out jointly between union and management. Before year-end, representatives of both the local and international UAW-CIO agreed to the proposal and a vote among employes showed a 90 per cent approval by those voting. After the union failed to come up with a feasible suggestion, company officials proposed a system which ultimately was adopted and called the Costs Savings Sharing Plan. The basic principle of the system is that extra earnings are in direct proportion to savings on production costs. They are computed by determining the ratio of labor cost to the sales dollar.

Analysis of the period from Oct. 1, 1945, to Jan. 22, 1946, a typical period, showed the hourly wage cost was 30 cents of each sales dollar. Thus, 30 per cent of the dollar sales for any month is considered the allowance for hourly-rated labor, and the difference between the allowance and the amount actually paid that month represents the gross earnings under the plan. For example, if hourly wage payments should total $210,000 a month for two consecutive months, but sales should run $700,000 one month and $840,000 the following one, $140,000 of additional goods would be produced at no increase in labor cost. By multiplying the monthly sales of $840,000 by the 30 per cent labor ratio, an allowance of $252,000 for hourly rated labor is obtained. Wages paid, amounting to $210,000 is subtracted, leaving $42,000 to be divided equally among employes and the company. To find each employe's share, the workers' half, $21,000, is divided by the total number of hours worked. In this instance, a man-hour total of 160,000 would mean an extra payment of 13.1 cents an hour for each hour worked during the month. The plan was approved by union representatives and the employes, and went into effect April 1. Basic fundamentals of the plan are as follows:

1. The labor allowance ratio is 30 per cent, based on the period between Oct. 1, 1945 and Jan. 22, 1946.

2. Savings on the predetermined percentage is divided equally between the company and the hourly rated employes.

3. Employes will participate equally according to the actual number of hours worked during the period.

4. Savings will be accumulated on a three-month basis and distributed within 30 days after the end of each period. However, earnings per hour will be

(*Turn to page* 84, *please*)

CASTINGS . . . *but they were "machined" in the mold!*

Now—all the advantages of Monel, Nickel and Inconel—available in PRECISION CASTINGS

HERE'S another way to lick tough design problems . . . *precision castings of Monel, Nickel and Inconel.*

The new INCO Precision Castings Plant is now in operation . . . built and equipped after several years of pilot plant study, after thousands of experimental castings.

Check what this development means:

1 **Precision Castings of Precision Accuracy** — INCO precision castings are commonly made to tolerances of ± 0.003", and frequently to even finer tolerances.

2 **A Saving in Time and Money** — In general, INCO precision castings eliminate machining or other fabricating operations normally involved in making parts. This is particularly noteworthy where the design calls for intricate features and contours. INCO precision castings are delivered to you with a sand-blasted finish—and usually that's all the finishing these castings require before being assembled into the finished product.

3 **Broader Use for the INCO Nickel Alloys** — The flexibility of design permits the INCO Nickel Alloys to be used in shapes which frequently were neither economical nor practical to obtain as sand castings or by machining from forged stock or deep forgings.

4 **Dependable Source of Supply** — INCO handles precision castings as a mass production process . . . you can count on quick, steady production from INCO.

•

Perhaps an INCO Nickel Alloy precision casting is your answer to the need for faster production...for hardness, greater protection against stress, corrosion, high temperatures, wear and fatigue.

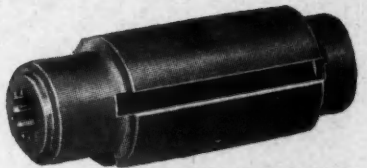
Let's go over your job together. Just send us a blueprint (or an actual sample). We'll be glad to work out all the information you want.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N.Y

NICKEL (INCO TRADE MARK) **ALLOYS**

MONEL* • "K" MONEL* • "H" MONEL* • "R" MONEL* • "S" MONEL* • INCONEL* • NICKEL • "L" NICKEL* • "Z" NICKEL*

INCO PRECISION CASTINGS SAVE TIME AND MONEY



FUEL PUMP ROTOR

Would require a number of operations on several different machines. Note grooves on internal surface.

CLUTCH GEAR

Saved complicated machining. Also avoided at least one sub-assembly, i.e., force-fitting, welding or brazing the projecting key on small end.

FLIGHT CONTROL INSTRUMENT COVER

(*Cutaway section*) Originally machined from bar stock, taking a 9-day production schedule. Note intricate recesses and studs in recesses.

Above parts are made of "S" Monel

posted monthly on the bulletin boards in the plant.

5. Each three-month period shall stand on its own feet.

DEFINITIONS:

A. Labor cost includes all wages paid to hourly-rate workers except the following: overtime and night shift premiums, wages paid for capitalized items, vacation allowances, hourly-rate wages paid to supervisory or other employes who are serving a probationary period before being placed on salary, wages paid during inventory periods, special payments to employes entering or returning from the Armed Forces, and other forms of special payments.

B. Net Sales include all sales except termination sales that resulted from charges involved before installation of the plan, disposal of equipment or other company property, sale of fittings, loom, armor, supplies or other material items on which no work has been performed, and fluctuations of finished parts in the shipping room to be added or deducted from net sales for increases or decreases in this bank.

All new employes will participate in the plan only after serving the 30-day probationary period. Wages paid during that period, however, are a part of the net applicable wages charged against the plan. Employes who have served their probationary period and who are released for reason of layoff or discharge and those who quit voluntarily will be eligible to receive their share of earnings under the plan for the actual hours they worked during the particular quarter.

Since Bundy manufactures straight tubing, fabricated forms, and Monel and BiMetallic products, the ratio of hourly wages to sales of the three categories may be affected, and provision is made for adjustment of these three factors if they affect the predetermined ratio by 1 per cent or more per month.

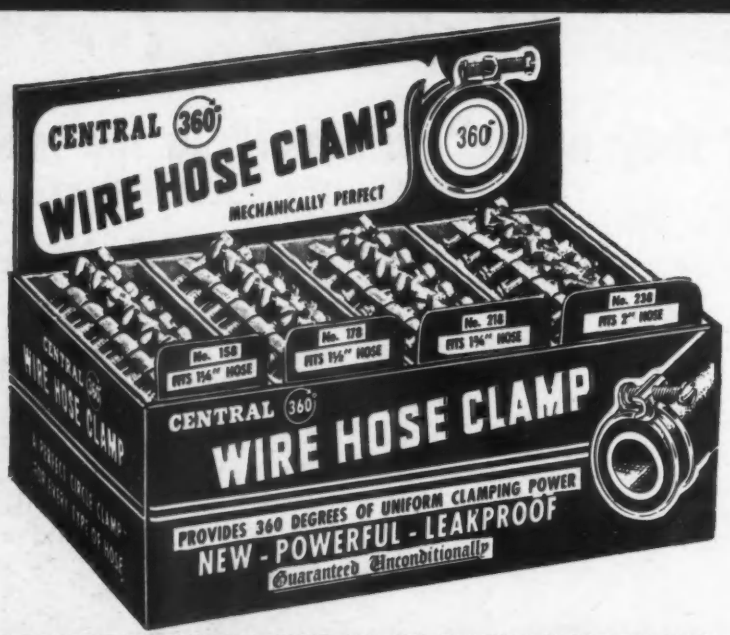
Results of the plan since its inception have been good. On a tonnage basis, production has gone up from one ton a month to 1.45 tons per employe. By the end of August, worker efficiency had gone up 35 per cent. Bundy officials attribute this to reduction in loafing, spending unnecessary time in the washroom, and leaving work before the quitting signal. In the first five months, absenteeism dropped to six per cent, a decrease of 35½ per cent from the base period average. Production of scrap, a vital factor in extra earnings, decreased seven per cent in the first three months under the figure for the last three months of 1945.

Employe earnings also indicate the plan is working well. In the first three-month period, extra earnings averaged 22 cents an hour. Of 1178 eligible employes, 197 worked full time and received extra earnings of $118.27 each. Total distribution was $114,219 to workers, with the company benefiting by a like amount. During the second quarter, average bonus per employe was 20 cents per hour, being somewhat lower because of hot weather and vacations during July. Highest monthly average was April, when extra payments earned averaged 24 cents an hour. Under the plan, each worker, regardless of his base rate, receives the same extra hourly bonus. Another result of the CSS plan is reduction in the number of hours spent by stewards and committeemen on grievances. During the first three months, time out for this purpose amounted to more than 900 fewer hours than in the last quarter of last year.

Two questions raised by the union have been settled satisfactorily, at least for the time being. The first related to company attitude on limitation of future earnings, a fear always expressed by unions when discussing incentive plans. The company gave assurance that there will be no ceiling. The second question, also an ever-present issue in incentive plan opposition, was the effect on employment resulting from increase in production. Bundy demonstrated that the company now has recalled its entire seniority list, all veterans are rehired, and new employes have been taken on.

(*Turn to page 86, please*)

THIS BEAUTIFUL DISPLAY FEATURES THE CENTRAL "360" WIRE HOSE CLAMP



THESE VERY ATTRACTIVE 3 COLOR CARTONS ARE YOUR SILENT SALESMEN—THEY TELL THEIR OWN STORY—THEY REALLY SELL CLAMPS!

DISPLAY CARTON HOLDS 4 BOXES

Here is the ideal package. This beautiful 3 color carton compactly carries 4 boxes of radiator hose clamps. Each box is a separate size. Each box is plainly marked in large type on tab to indicate the stock number of the clamp and the size of the hose that it services. Included are the four sizes that fit 90% of all radiator hose.
This assortment—No. 60—provides the mechanic with a complete stock of radiator size clamps. It's all the stock he needs to service practically any make of car or truck.

CENTRAL EQUIPMENT CO.
902 S. WABASH AVE. CHICAGO 5, ILLINOIS

CENTRAL EQUIPMENT CO.
902 S. Wabash Avenue . . . Chicago 5, Ill.
Gentlemen: Please send FREE sample of your 360° Hose Clamp and your Bulletin No. 110B
Name.....
Address.....
City..... State.....

Engineering Library

On the basis of its experience thus far, the Bundy management probably could term the plan an unqualified success. However, company officials are reserving their opinion about the plan as a long-range proposition. They point out that, so far, factors have all been favorable in a rising market, with wages, prices and demand all increasing. What will happen when adverse factors, such as lower prices, falling sales, and general economic reversal set in is not presently known.

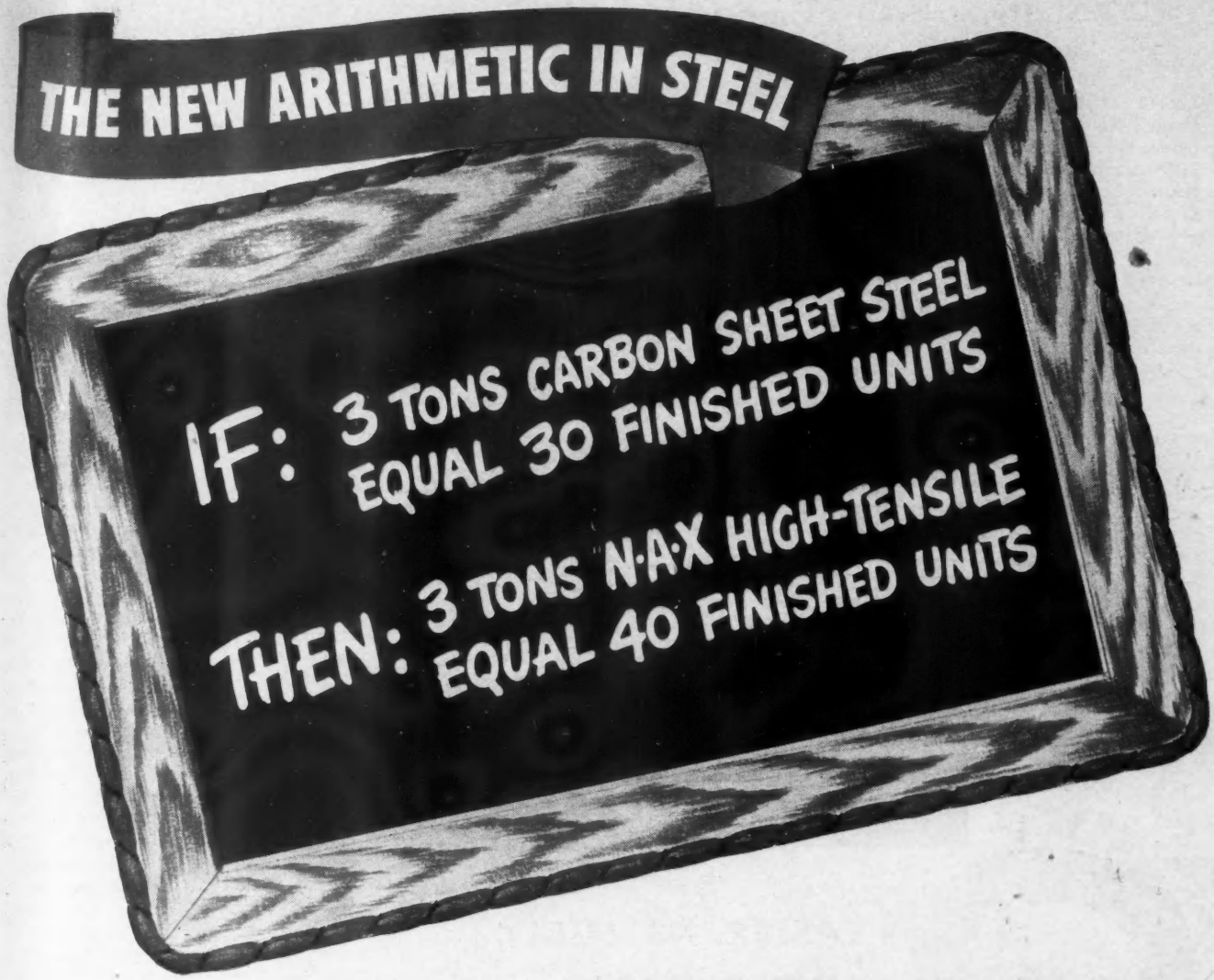
The CSS plan as developed at Bundy offers an interesting case study in labor relations. Whether it would be accepted and workable at other plants is an open question. It should be remembered that the union has not softened its position in regard to wage incentives in general. In fact, union representatives were insistent that the plan be labeled something other than incentive, but regardless of the tag placed on it, the system evolved is certainly an incentive plan, since it requires extra production before extra earnings are received. Another interesting point to remember is that the union had a Hobson's choice of either accepting some type of incentive plan, unpalatable though it might be, or to see several hundred dues-paying members lose their jobs through closing of the plant.

Labor Monopoly (*Continued from page* 15)

The same is true in labor. The only and everlasting protection of the worker's independence and economic freedom is the presence of competing buyers for his service, that is, competing employers, just as competing sellers are his protection when he spends his wage as a buyer. As workers from monopoly groups against particular employers, they may be shutting off each employer from other sources of supply to the monopoly group's own seeming benefit; but by that very act they are also shutting off other workers from access to these employers. Thus step-by-step the workers are shutting each other out and so losing the very roots of their independence. They become the prisoners of the monopolies they create. As such side-by-side labor monopolies employ their coercive power to obtain above market-price wages, then some of the workers are priced out of jobs and find themselves with nowhere to go—except to charity. They are shut out from other employment by reason either of the same over-pricing elsewhere that is responsible for their own disemployment, or by the presence of seniority and other rules designed to protect these monopolies against worker competition. Such monopolies operate most brutally against competition of the non-working with those working. They tend to create unemployment and render it chronic. That is the simple economics of it. That is the pathos in it.

With this understood, the nature of monopoly as one of the great roads to state-ism becomes readily apparent. Thus when recession comes these monopolies will certainly strive with all their power to maintain existing wages. Wage cost is at least three-quarters of all costs. This cost rigidity will hamper and hinder the realignment of employment and production to meet the changing pattern of demand as the war-born shortages are made good. It will act as a destroyer of the profit incentive to create new jobs. It means, in short, that we may have to take our licking in pronounced and prolonged unemployment instead of in swift-moving, flexible price, profit and wage adjustments that will keep most people working most of the time. That, in turn, permits those who wish to do so, however untruthfully, to scream out that private enterprise has failed, and that government must step in—with multiplied bureaucracy and a bigger printing press, together with their unlimited capacity to perpetuate, rather than cure, maladjustments in production, employment, prices and costs.—*From a paper read before the Detroit Economic Club.*

Engineering
Through the services and facilities of our large staff of competent engineers the basic engineering of the original Atwood Clutch principle is being continuously advanced to provide the most effective solution to your clutch problems.


THE NEW ARITHMETIC IN STEEL
IF: 3 TONS CARBON SHEET STEEL EQUAL 30 FINISHED UNITS
THEN: 3 TONS N-A-X HIGH-TENSILE EQUAL 40 FINISHED UNITS

A DEMONSTRABLE FACT: MANY USERS OF HOT AND COLD ROLLED SHEETS CAN INCREASE PRODUCTION OF UNITS 33% BY MAKING 3 TONS OF STEEL DO THE WORK OF 4

These days, the many production advantages of N-A-X HIGH-TENSILE steel are more important and more apparent than ever before.

With this low-alloy, high-tensile steel, you can use lighter sections . . . lighter, but of *equal* strength and *greater* durability. Lighter sections mean less steel per unit, more units per ton. Production of four units for every three units normally produced is a typical result.

Good formability permits N-A-X HIGH-TENSILE to be deep-drawn and formed to intricate shapes. At the same time, its greater corrosion-resistance, excellent weldability, high fatigue-resistance and great impact toughness bring both product improvements and production savings. Many fabricating, finishing and handling operations are simplified or eliminated.

The specific production increases and economies that can be effected in your plant through the use of N-A-X HIGH-TENSILE steel can be determined, of course, only by a study of your particular problems. Our metallurgists and engineers are at your service.

MAKE A TON OF SHEET STEEL GO FARTHER
Specify—
N-A-X
HIGH-TENSILE STEEL

COPYRIGHT 1946
GREAT LAKES STEEL CORP.

GREAT LAKES STEEL
Corporation

N-A-X ALLOY DIVISION • DETROIT 18, MICHIGAN
UNIT OF NATIONAL STEEL CORPORATION

Progress in Engine Design

(*Continued from page* 20)

stroke, speed, or in combinations of them. Similarly, a straight line indicates no change during the interval. 1948 can be made to weigh 500 to 1000 pounds less by the use of light-weight metals and if body shape can be improved to reduce wind resistance sufficiently, then perhaps a present engine with 100 hp rating will be replaced by one of say 90 hp. At this writing there seems to be no scramble to sharply reduce engine output.

Another variable of formidable proportions is the fuel. It poses the old saw—which came first the chicken or the egg. Do we wait until the petroleum industry has super-gas at the pumps before bringing out new engines or do we develop the engines and hold them until the super-gas is in the pumps. What actually happens is that designers are kept pretty well in touch with the refiners' advance plans and plan their engines in advance of the gas pump. After the engines have undergone a lengthy period of design, block testing, and road testing, they are held in readiness for introduction at the right time.

There are at least four powerful stimuli to a radical change in engines:

1. The effect of competition
2. The workings of the inexorable law of diminishing returns mentioned earlier
3. The trend to lighter cars which demands lighter engines
4. The pressure of advanced manufacturing methods

The last point warrants some discussion. Without fanfare at the moment, many plants are in the throes of equipment modernization and are taking advantage of the advanced techniques offered by the machine tool builders. We have seen a great deal of this activity already. It is reasonable to assume that the economic pressure of competition armed with modern manufacturing facilities will force others into line as a measure of self protection.

Where modernization is taking place, it is only good management sense to plan machine shop lines capable of reasonable economical change-over from an existing product design to the new design. It is quite probable, therefore, that modernization has taken future design well into account. On the other hand, if millions of dollars are spent now, the pattern of future product design will become rather fixed whether one likes it or not.

While on the subject, reference should be made to the excellent paper entitled "Potentialities of the New Fuels in the Design of Passenger Car Engines" by Earl Bartholomew, Ethyl Corp., which was presented at the 1946 SAE Summer Meeting at French Lick. Bartholomew paints a picture of the prospects in authoritative fashion and lays the groundwork for intelligent planning by designers.

• FASTER ASSEMBLY
• LOWER COST
• ABSOLUTE SECURITY

Handle ONE part instead of TWO

When you mount controls on the dash of your cars, you want them to remain tight in service. Self-locking Palnuts do this job unfailingly—and you only have to handle one inexpensive part to achieve it.

As a result, Self-locking Palnuts save in material cost and in assembly cost, while giving you a vibration proof assembly.

Available in a variety of sizes, covering the most popular control bushings. Send for free samples. Literature on request.

THE PALNUT COMPANY, 60 Cordier St., Irvington 11, N. J.

Self-Locking PALNUTS

1946 Registrations

(*Continued from page* 45)

are the highest registrations recorded for any year with the exception of 1941, the previous peak year, when 34,152,407 vehicles were registered.

At the end of this year there will have been registered during the previous 12 months very close to 27,496,096 passenger cars and taxicabs as compared with 25,398,824 during 1945, an increase of 2,097,272 or 8.3 per cent. Trucks will show a gain of about 741,000 in registrations from the total of 4,862,307 during 1945 to the expected total of 5,603,749 during 1946. This is an indicated increase of approximately 15 per cent. Buses are expected to jump from 118,655 to around 134,130.

Present returns show increases in every state and the District of Columbia. Arkansas indicated the greatest percentage gain of 22.1 followed closely by New Hampshire with 20.4 per cent.

(*Turn to page* 90, *please*)

Preventing Trouble

IS FAR CHEAPER THAN ATTEMPTING TO CURE IT LATER

The first requirement for the successful operation of mechanical assemblies which incorporate rotating or reciprocating shafts is an adequate uncontaminated lubricant supply.

Keeping that supply confined within the mechanism and excluding destructive abrasive and corrosive matter is precisely what "Perfect" Oil Seals accomplish consistently. Before that design of yours goes too far talk to a Chicago Rawhide engineer. He may be able to save you both time and effort.

CHICAGO RAWHIDE MANUFACTURING COMPANY

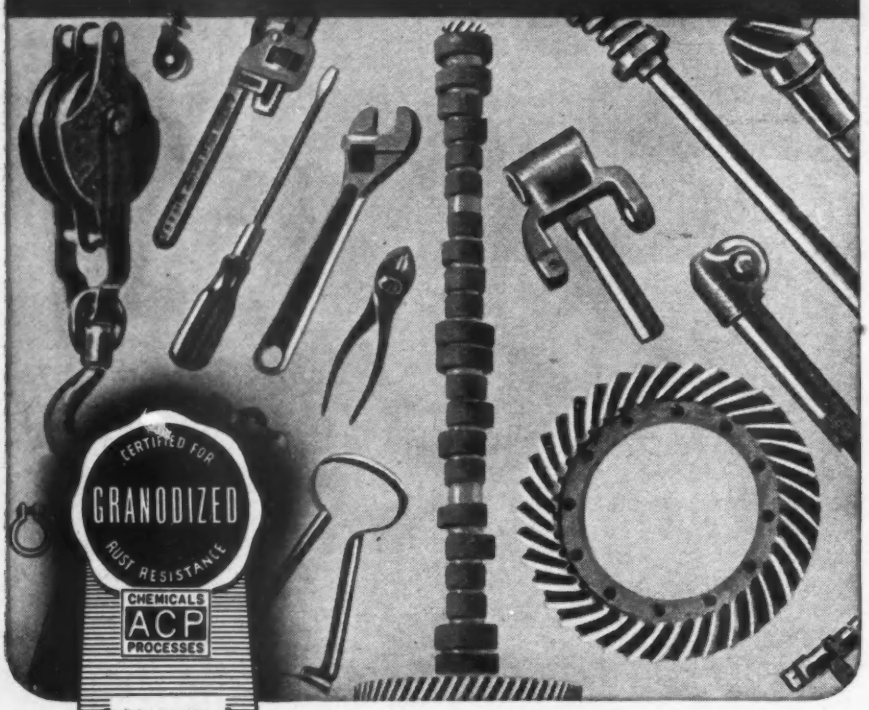
1310 ELSTON AVE. • CHICAGO 22, ILLINOIS

PHILADELPHIA • CLEVELAND • NEW YORK • DETROIT • BOSTON • PITTSBURGH • CINCINNATI

67 YEARS MANUFACTURING QUALITY MECHANICAL LEATHER GOODS EXCLUSIVELY AND NOW SIRVENE SYNTHETIC PRODUCTS

THERMOIL-GRANODINE

FOR RUST PREVENTION



*THERMOIL-GRANODINE creates on steel an oil-absorbing, paint bonding, crystalline coating of iron and manganese phosphate, integrated with the base metal.

CORROSION RESISTANT

—THERMOIL-GRANODINE treated surfaces, when oiled, prevent rust and corrosion and provide a durable foundation that tenaciously holds organic finishes. Thermoil-Granodine is also excellent rust protection for tools, nuts, bolts and unpainted replacement machine parts.

FRICTION MINIMIZED

—THERMOIL-GRANODINE coatings, when oiled, maintain lubrication and prevent excessive wear on friction parts—eliminate break in troubles when new friction parts are run at high speed or under heavy pressure. Thermoil-Granodine provides an ideal coating on piston rings, gears, tappets, valves, camshafts, spiders, etc.

Cold SPRAY-GRANODINE

*Cold SPRAY-GRANODINE may be *applied at room temperature* and provides a uniform, smooth zinc phosphate coating—a superior base for lustrous, enduring paint finish. Cold SPRAY-GRANODINE is of special interest to fabricators of automobile bodies, fenders, refrigerators, cabinets and in general for the proper preparation of sheet steel products for durable and lustrous finishes.

* Trade Mark Reg. U. S. Pat. Off.

AMERICAN CHEMICAL PAINT CO.
AMBLER ACP PENNA.

Seventeen other states will all show over 10 per cent increases in 1946 over 1945. The least percentage gain is recorded in Nebraska with only 2.9 per cent. In total number of registrations California is in the lead with 2,863,324 cars, trucks and buses registered. New York is second with 2,619,000 registrations. Ohio, Illinois, Texas, Michigan, New Jersey and Indiana all with over a million vehicle registrations, follow Pennsylvania in the order named.

There are three important factors which account for these large gains in motor vehicle registrations. First, it must be remembered as we mentioned earlier in this analysis, that our estimates are for the registration year. This means that a few states such as Connecticut, Ohio, Pennsylvania and one or two others whose registration year will not end before March or April of 1947 will receive an increasing number of new vehicle registrations than those states whose registration year ends on December 31 of this year.

The second and highly important factor accounting for this high rate of increase is that of junking. It is quite evident when the expected vehicle production figures for U. S. consumption are compared with the increases in registrations that junking was at its lowest ebb. It is estimated that passenger car production for domestic use during 1946 will be between 1,900,000 and 2,000,000 units. Trucks for domestic use should number around 750,000 units. These vehicle production estimates are approximately the same as the increases in registrations which implies that there have been no cars or trucks junked during the year. However, we do know that a few of the vehicles that were registered earlier in the year are now reposing in some junk yard or along the highways, no longer fit to use.

The third and last, but not least, important factor to the greatly increased registrations during 1946 as compared with 1945 has been the sale of surplus property military vehicles to civilian users. The War Assets Administration reports that through June of this year 171,685 trucks, 14,242 Jeeps and 19,709 passenger cars had been sold as surplus. Just how many more vehicles will have been sold during the remainder of the year it is hard to predict, but you can rest assured that the sale of surplus trucks will have had quite a bearing on the sizable truck registration increase.

New Idea

(*Continued from page* 21)

consists of the following operations and installations:

Frame boring from top; frame turned over; front transverse spring suspension; brake mechanism; upside down frame placed crosswise on conveyor; rear springs; assembled rear axle; brake cables; gasoline lines; manifold; exhaust pipe; automatic pickup of frame by overhead conveyor

(*Turn to page* 92, *please*)

ONE SURE WAY TO TELL
WHAT A BROACH IS WORTH

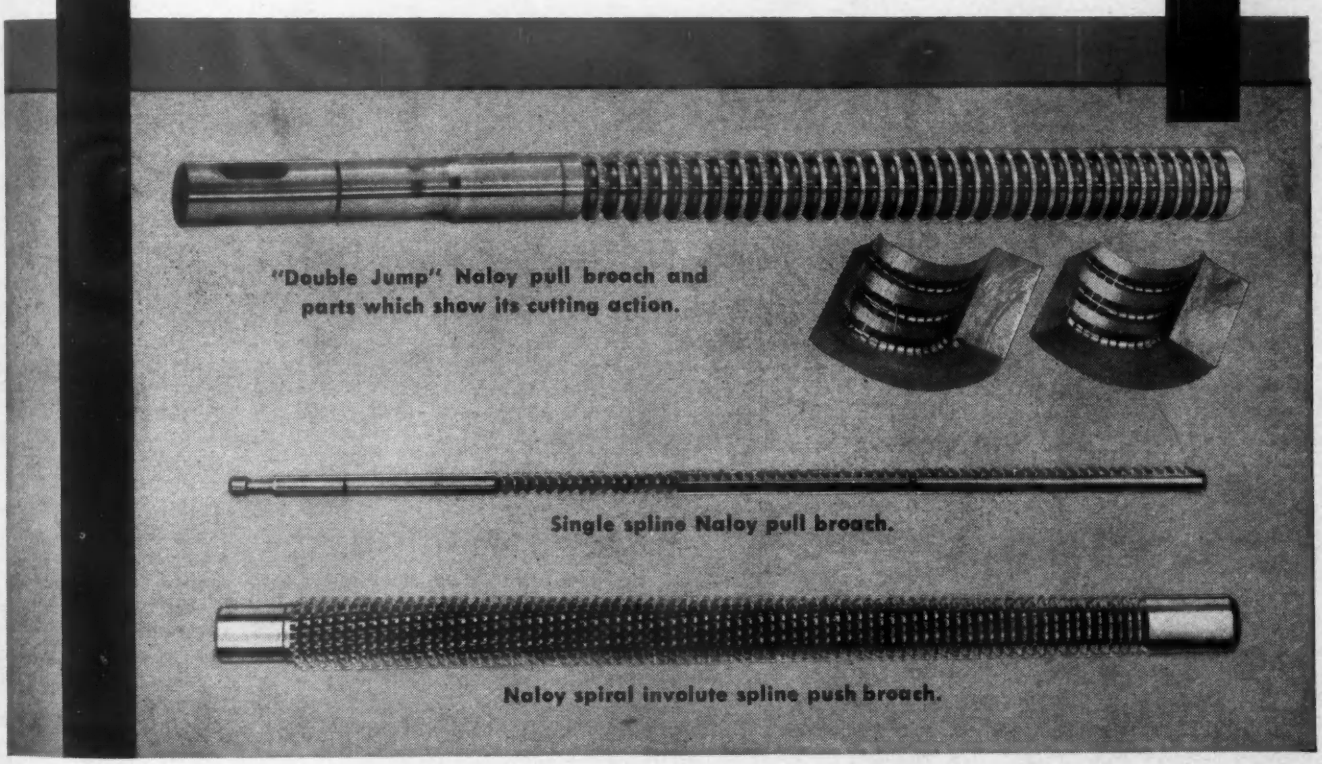
It's SIMPLE, STRAIGHTFORWARD and FINAL

$$\text{BROACH COST} = \frac{\text{Price}}{\text{Number Acceptable Parts Broached}}$$

It tells the whole story—leaves nothing to argue about—no recriminations.

Compare NALOY BROACHES in this way with any other tools you can buy or make—then standardize on what you find to be the lowest cost tool regardless of who makes it.

Industry has been using Red Ring Naloy Broaches in steadily increasing numbers for the past 15 years.



"Double Jump" Naloy pull broach and parts which show its cutting action.

Single spline Naloy pull broach.

Naloy spiral involute spline push broach.

NATIONAL BROACH AND MACHINE CO.

1940 **5600 ST. JEAN** *RED RING ○ PRODUCTS* **DETROIT 13, MICH.**

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

and transfer to head of final assembly.

Clutch and brake levers; gas tank; two-section propeller shaft; paint underside; steering assembly and tie rods; frame turned over; steering post; paint topside; engine; rear bumper with dust deflector; motor accessories; body drop.

(Studebaker-built bodies, progressing on lines immediately above chassis line, have meantime been wired and fitted with rear wheel shields and hoods).

Shift controls; front end (built by a sub-assembly and sequence of subs to contain radiator, front fenders, headlamps and grille); front bumper; steering wheel; battery; floor mats; wheels and tires; rear seat back and cushions; front seat back and cushions; wheel discs.

This ends the physical job of assembly but does not release the car. The automobile is backed off the line under its own power and proceeds through a series of inspections and adjustments before reaching the "dollup line." The dollup line serves as a final check in the elimination of possible imperfections. Cars travel hood-first in the final stages.

Aircraft Exhaust Systems (*Continued from page* 42)

gas, transmit it through the suspension system, which lies in the exhaust stream, to the outer exhaust pipe and into engine and airframe structure. The main problems have occurred in suspending the inner fairing and mounting the long tail pipe. Because of jet engine service requirements, quick-disconnect fittings in the exhaust system are supplied. These have been a source of concern. Tests are being conducted on better materials and new designs which hold promise for real progress in these fields.

Better metals will have to be derived if future problems are to be solved. The use of variable nozzles will soon be specified to permit the use of the proper nozzle exit areas for various power settings of the jet engine. Military aircraft will require them to get rapid thrust increase while in flight to overcome the lag between opening the throttle and the acceleration of the jet engine to full speed. Their use will be demanded for intermittent employment of the reheat cycle which provides extreme increases in thrust by introducing and burning fuel in the exhaust tailpipe.

This means operating with exhaust gas temperatures in the range of 3000 F. The best materials available today cannot be expected to operate successfully at metal temperatures above 1300 F. The large power resources which would be immediately available from the use of variable nozzles and reheat cycles, cannot be adequately realized because materials are not available to withstand the high temperatures produced.

The main stumbling block, therefore, in the path of exhaust equipment improvement lies in the metallurgy of available materials. Present day stainless steel and Inconel are not adequate. A new material, 19-9DL, is being used to some extent. It has a higher tensile strength at elevated temperatures and a higher scale point. However, not much is known about its carbon absorption rate. A knowledge of this characteristic is extremely important because this factor causes deterioration of stainless steel. In spite of the slightly improved properties of 19-9DL it is not believed that this material will be adequate. We are operating beyond the limitations of stainless steel and Inconel and are approaching the limitation of 19 9DL even before it has had a chance to prove itself.

A material is required that has a scale point above that of exhaust gas temperatures, a comparable increase in tensile strength along with considerably reduced carbon absorption rates if the carbon affects its strength and deterioration factor. This unknown material would be put to good advantage in exhaust systems, gas turbine engines and numerous other heat applications.

COOLING SYSTEMS, TOO
need CONTROL!
Controlled cooling, as achieved by modern cooling systems with Dole Thermostats, is a simple assurance of top performance. Savings in gas, oil and motor wear through reduced crank case dilution are important plus values.
DOLE
Thermostats
in a range of types for every car
THE DOLE VALVE COMPANY
1901-1941 Carroll Avenue, Chicago 12, Illinois
Los Angeles
Detroit
Philadelphia

Racetrack in a Laboratory

George DeHaven and Forrest Frampton
J & H Associates, Engine Test Laboratory

Extra values through

JACK & HEINTZ

Mass Precision

You are looking into one of the "torture chambers" of our engine laboratory where the world's largest pressure-die-cast, four-cycle engine is going through its paces. Under sustained tests this new Jack & Heintz slide-valve engine reveals exceptional fuel economy. Its weight is far less than that of conventional automobile engines. It is more efficient and has a much wider speed range.

This new engine is typical of Jack & Heintz achievements through *mass precision.* This rare combination of high precision and mass production is creating better engines, electric motors, refrigeration compressors, aircraft accessories, bearings and magnetos *today,* and is developing other revolutionary products for *tomorrow.*

JACK & HEINTZ PRECISION INDUSTRIES, INC., *Cleveland 1, Ohio*

New Products

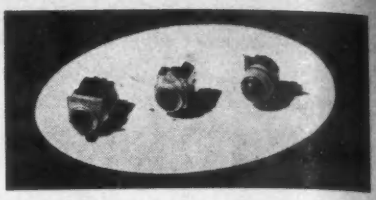
(*Continued from page* 50)

tween the button and the main body of the unit.

The momentary-contact push-button units are available in several forms. The single-pole unit provides a normally-open and a normally-closed circuit, The three-point unit provides two normally-open circuits with common connection. Double-pole units are also available with either normally-open or normally-closed circuits. All contacts are double-break, and made of silver.

The selector switch unit is available in single-pole double-throw, or double-pole single-throw forms. Contacts are cam-operated. Heavy springs and sliding contacts are said to insure positive action.

The indicating-light unit has the same single-pole mounting arrangement as the push-button units and selector switches, which simplifies the construction of special or built-in push-button stations with indicating lights.

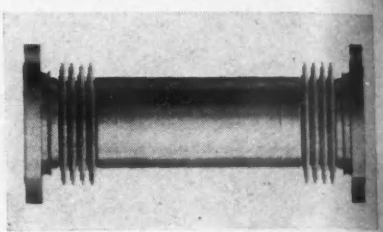


G-E push-button unit, selector switch and indicating light

They are available for use on 110-125 or 250 volts, a-c or d-c, and may be used on higher voltages with separately mounted resistors.

Standard line of Offset Joints

MagniLastic Division of Cook Electric Co., 2700 Southport, Chicago 14, Ill., offers a standard line of offset joints, another in its series of packless



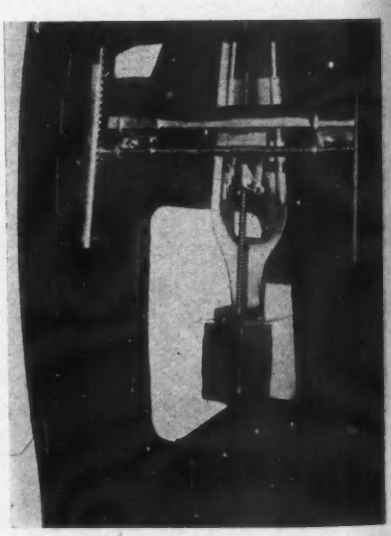
MagniLastic offset joint

expansion joint types.

This latest addition to the MagniLastic line fills a need for a standard flexible unit for joining pipe terminals that are out of line or offset. This condition may be due to accumulated excess tolerances in piping sections, to settling

(*Turn to page* 96, *please*)

Electric Window Lift



Installation of a new electric window lift brought out by the F. L. Jacobs Co., 1034 Spruce St., Detroit 1, Mich., is shown above. This completely automatic, jam-proof window lift is controlled by a button on the door. A complete set of buttons is also on the instrument panel so the driver can control windows individually or in combination.

- Buell Air Horns are tops in warning signal efficiency.
- Installed as original equipment on many Trucks and Buses.
- They reduce maintenance costs by decreasing stops, starts and slowdowns.
- All records prove that they save tires, brakes, clutches and gears.
- Cut gas and oil consumption.

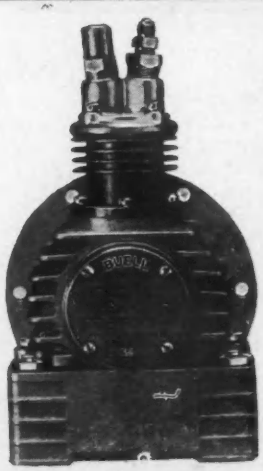
With a Buell the driver has greater security, maintaining a steady cruising speed. Slowing a 20 ton load from 50 MPH to 30 MPH means destroying a lot of energy thru brake lining and tires. It is replaced by burning more gasoline, increasing load on engine, and tires again, to regain speed. This all costs money. We believe a Buell Air Horn is worth $100.00 yearly on any heavy highway vehicle. Then remember a Buell will last more than 10 years. How would you rate a $100.00 investment that earned $100.00 yearly for 10 years. Ask the man who has a Buell.

BUELL AIR COMPRESSOR

- Used on Passenger Cars, Trucks, Buses, Boats and Planes.
- Small and compact in size . . . efficient and powerful in action.

Buell engine-driven compressors supplied air to operate air brakes in thousands of R.C.A.F. aircraft. Only a combination of quality and precision workmanship could meet the requirements of this type of service.

Designed for compactness and light weight, they are far more efficient and powerful than their size indicates. Let us prove their adaptability to your needs.



BUELL MANUFACTURING CO.
2975 Cottage Grove Ave., Chicago 16, Ill.

HANSEN

Couplings

ACE INDUSTRY

HANSEN PUSH-TITE COUPLING

is composed of two parts —socket and detachable plug. They come in a wide range of standard sizes and are used for air, oil and grease. Socket and plug can be had with either male or female ends.

HANSEN 100 SERIES GASOLINE COUPLING

is composed of two parts —socket and detachable plug. Comes in a wide range of standard sizes. Both coupling and plug can be had with either male or female ends.

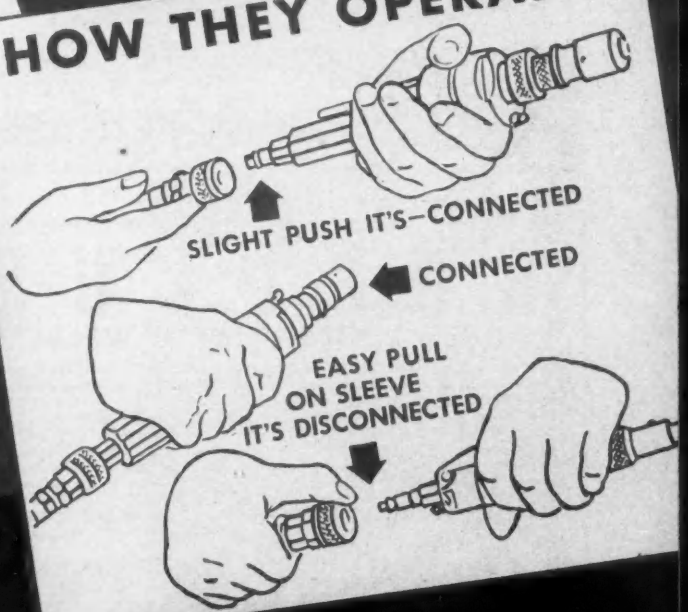
HANSEN 600 SERIES OXYGEN COUPLING

consists of socket and detachable plug and like the other Hansen Couplings they can be had in regular standard sizes with either male or female ends on socket and plug.

HANSEN 700 SERIES ACETYLENE COUPLING

is composed of socket and detachable plug and comes equipped with standard left hand acetylene thread. Sockets and plugs can be had with either male or female ends in standard sizes.

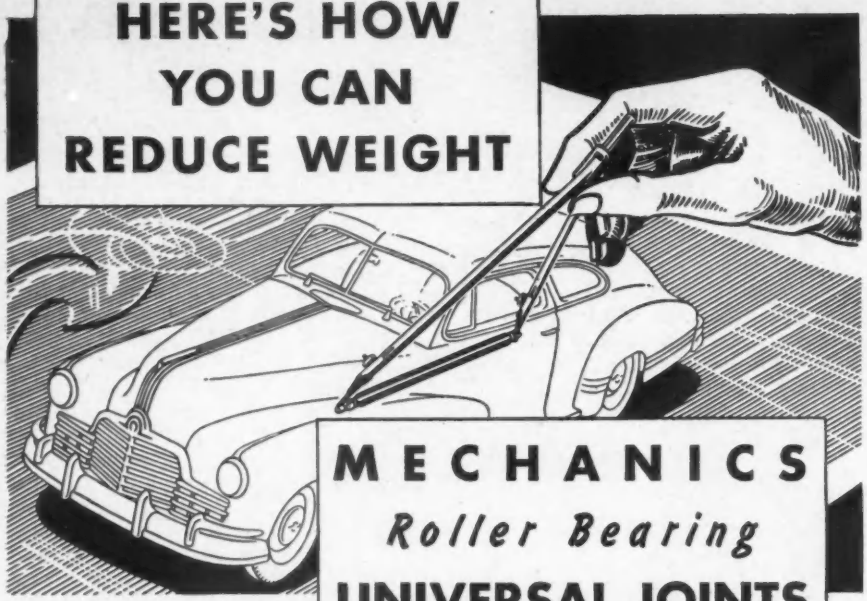
HOW THEY OPERATE!



Send for free catalog number 46 which contains the complete line of Hansen industrial equipment

HANSEN MANUFACTURING CO.
1786 EAST 27th STREET • CLEVELAND 14, OHIO

HERE'S HOW YOU CAN REDUCE WEIGHT



MECHANICS *Roller Bearing* UNIVERSAL JOINTS

Because the slip-on-the-transmission-shaft feature of MECHANICS Roller Bearing UNIVERSAL JOINTS and Tubular Shaft assemblies eliminates the conventional splined stub shaft, an appreciable *weight reduction* is accomplished. Let our engineers show you how this and other MECHANICS features will help give your product competitive advantages.

MECHANICS

MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner
2020 Harrison Avenue, Rockford, Ill. Detroit Office, 7-234 G. M. Bldg.

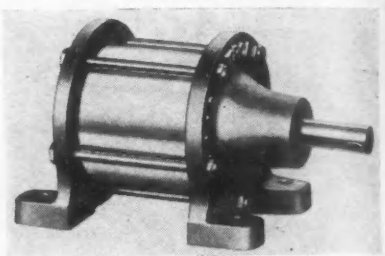
and shifting at anchor points or hangars, thermal expansion and contraction of pipes and mountings, or to variations in operating conditions.

The MagniLastic offset joint is constructed with an equal number of expansion flanges on either end of an insert section. Length of unit and number of flanges are determined by misalignment condition to be corrected.

Offset joints are supplied with bellows flanges from any of the MagniLastic standard expansion joint series which includes pressures from vacuum to 1000 psi, pipe sizes from ½ to 24 in. and temperatures from —300F to 1600F. Joints of stainless steel, Monel, Inconel and copper cover all common corrosive conditions. End fittings are available in welding end or Van Stone bolted flanges.

Air Control Cylinders

Air-Trol, 2651 W. Lake St., Chicago 12, Ill., is manufacturing a line of air cylinders designed to expedite material holding operations for drilling, reaming, tapping, milling, grinding, injection and ejection, and other operations.



Air-Trol cylinder

Air-Trol features are: True-bore cylinders; non-rusting cylinder heads; and oilless (graphite impregnated) bronze ram bushings.

Sizes range from 1½ in. up; power factor from 1.76 times air line pressure.

Nylon Rods

Nylon rods which can be machined successfully are being produced in commercial quantities by The Polymer Corp. of Reading, Pa.

Using Du Pont's FM-1 nylon mold-

(*Turn to page 98, please*)

SURPLUS

SCIAKY ALUMINUM SPOT WELDERS

They are thoroughly factory-reconditioned, installed, serviced and "new-machine" guaranteed by the original maker.

They are offered at a savings of nearly one half. Welders formerly $9,100 to $10,160 are priced at $5,500 to $6,500, complete with rectifier . . . some with built-in rectifiers.

The machines are rated 50 KW and operate on the exclusive Sciaky Electromagnetic "Stored Energy" principle with patented "Variable Pressure Cycle." Capacity on aluminum and other light alloys: .016" plus .016" up to and including .080" plus .080". Speed on two thicknesses of .040" is 80 spots per minute. Throat depth is 36".

The quantity is limited. You are urged to act at once. Write, phone or wire for details.

SCIAKY BROS. Inc.
4915 W. 67th St. CHICAGO 38, ILL.

MILLHOLLAND

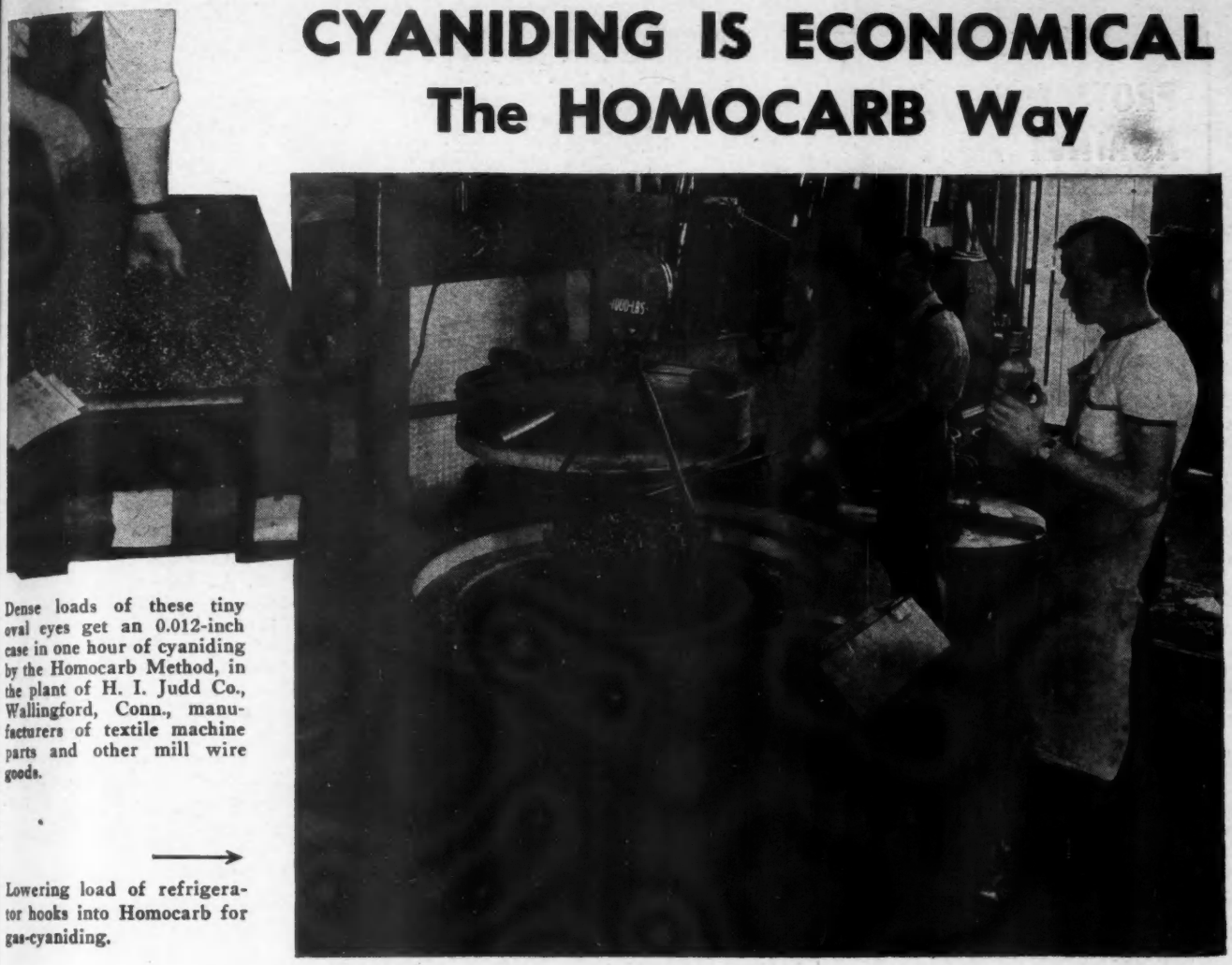
Automatic DRILLING - BORING MILLING - TAPPING Units

½ to 20 HORSEPOWER DRIVE

AUTOMATIC and SEMI-AUTOMATIC PRODUCTION MACHINERY

W. K. MILLHOLLAND MACHINERY CO.
Indianapolis, Ind.

CYANIDING IS ECONOMICAL
The HOMOCARB Way



Dense loads of these tiny oval eyes get an 0.012-inch case in one hour of cyaniding by the Homocarb Method, in the plant of H. I. Judd Co., Wallingford, Conn., manufacturers of textile machine parts and other mill wire goods.

→

Lowering load of refrigerator hooks into Homocarb for gas-cyaniding.

Cyanided steel parts can have not only file-hardness but uniform hardness and reduced distortion when they are gas-cyanided in the Homocarb way. Several reasons explain these results:

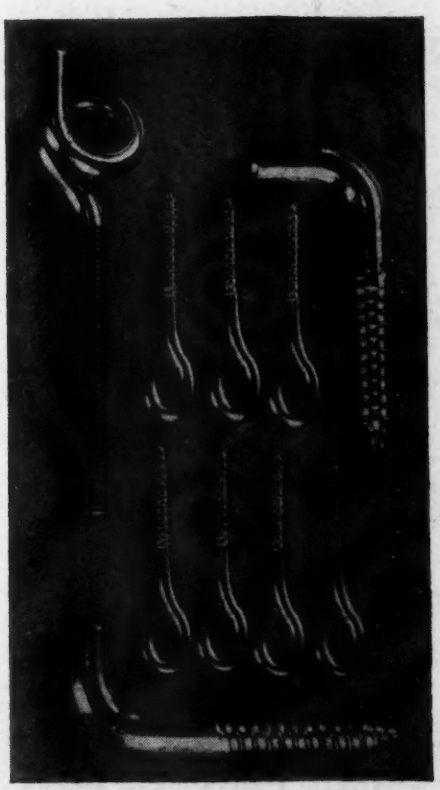
1. Gas cyaniding deposits no coating on parts, and work can therefore be quenched in either water or oil, acquiring file-hard case in either.

2. Fresh cyaniding gas is automatically fed to the Furnace in a continuous stream, and spent gas exhausts promptly from the Furnace. Cyaniding medium is thus always held at full strength.

3. This uniform medium acts on the work with great uniformity, because the entire internal design of the Furnace is planned for that one purpose. Gas follows the short, efficient Homo path from the fan, past the heaters and into work. Snug fitting prevents by-passing and ample power insures uniform penetration of dense loads. Results are constant and predictable.

4. Automatic control is by our newest, most economical method—Micromax D.A.T. It gives proportioning control by on-and-off contacts; normal voltage changes don't affect regulation. Rejects often vanish; are always insignificant.

If you have a specific problem, in cyaniding or carburizing, we suggest you write for Homocarb Catalog T-623, or a call from an L&N Field Engineer, as you prefer.



Judd Co. mill wire goods, actual size.

LEEDS & NORTHRUP COMPANY, 4966 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl. Ad T-623(23)

PROTECT PARTS AGAINST RUST

the new low-cost way with

OAKITE PROTECTIVE OIL

Drilled, machined, ground or sand-blasted parts that are marking time waiting further fabrication present perfect targets for attack by rust. Effective counter measures are called for here to reduce rust rejects . . . to insure that subsequent production proceeds in a smooth, trouble-free manner. You can get positive parts protection from rust by using that newly developed rust-preventive Oakite Special Protective Oil.

Method of application is simple . . . quick. Merely immerse parts either wet or dry in tank containing Oakite Special Protective Oil solution. Moisture, where present, is immediately dispelled . . . a thin, transparent protective coating of oil forms to guard surfaces against rust attack.

TECHNICAL DATA FREE!

Specially prepared 16-page booklet fully describes Oakite Special Protective Oil . . . offers many suggestions on a wide variety of useful applications such as protecting stored tools and parts from indoor rust; neutralizing fingerprints. Send for a FREE copy of the booklet or ask for an in-plant demonstration TODAY! No obligation.

OAKITE PRODUCTS, INC.
28A Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* CLEANING
MATERIALS • METHODS • SERVICE

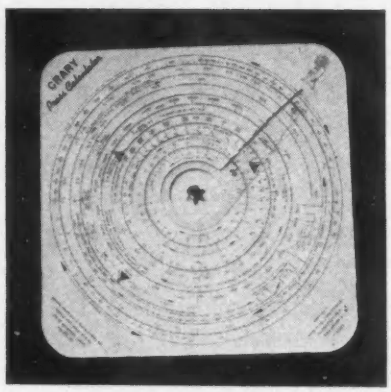
ing powder, the company has developed a new technique to extrude the plastic in rods ranging from ⅛ to 2 in. in diameter, and from 2 to 4 ft. in length. They can be machined accurately.

Previous products of nylon plastic have been made by extrusion or molding.

Calculator Determines Correct Press Size

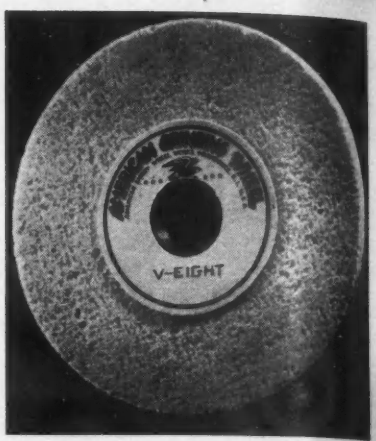
The Crary Press Calculator, made by the Calculator Co., Teaneck, N. J., determines the correct press size for various operations. It selects the correct size press by giving the crankshaft diameter and tonnage, at bottom of

(*Turn to page* 100, *please*)



Crary Press Calculator

"V-Eight" Grinding Wheel Announced by American



American Emery Wheel Wks., Providence, R. I., has just placed on the market this "V-Eight" grinding wheel. The new wheel is similar in structure to the porous wheels which have been widely used in recent years, but is claimed to hold its corners even under extremely heavy cuts and perform efficiently in dish and cup shapes. Its structure gives maximum air cooling for dry grinding and the open cells carry extra coolant when wet grinding.

AUTOMOTIVE and AVIATION INDUSTRIES Goes into Leading Plants in the Automotive and Aircraft Industries

GAS ON THE GROUND COSTS YOU PLENTY

And it's not necessary, because with a VENTALARM in the gas tank, there'll be no more blowbacks . . . no more costly spillage!

VENTALARM *whistles* until tank is filled to proper level, then stops, warning the attendant. Save your time and money with VENTALARM!

VENTALARM is standard equipment on 15 makes of cars, trucks, buses, and taxicabs. Ask for VENTALARM on your new cars or trucks.

VENTALARM
GAS TANK FILL SIGNAL

SCULLY SIGNAL CO.
88 FIRST STREET
CAMBRIDGE 41, MASS.

★ SUPERB ★

OIL RESISTANCE

is only one of Hycar synthetic rubber's unusual and valuable properties. Others are listed in the box at the right.

But most important, these properties may be had in an almost limitless number of combinations, each designed to meet specific service conditions of the finished Hycar part.

Our files contain more than 5000 recipes for Hycar compounds—each compound engineered to do a certain job. Parts made from HYCAR have seen service in *every* industry, giving long life, dependability, and economical operation.

That's why we say, ask your supplier for parts made from Hycar. Test them in your own application, difficult or routine. You'll learn for yourself that it's wise to use HYCAR for long-time, dependable performance. For more information, please write Department HH-11, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

CHECK THESE SUPERIOR FEATURES OF HYCAR

1. *EXTREME OIL RESISTANCE — insuring dimensional stability of parts.*
2. *HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.*
3. *ABRASION RESISTANCE—50% greater than natural rubber.*
4. *MINIMUM COLD FLOW—even at elevated temperatures.*
5. *LOW TEMPERATURE FLEXIBILITY—down to —65° F.*
6. *LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.*
7. *AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.*
8. *HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.*
9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

Hycar

Reg. U. S. Pat. Off.

LARGEST PRIVATELY PRODUCED BUTADIENE TYPE

American Rubber

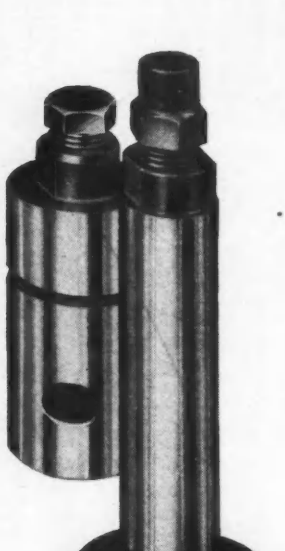
B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

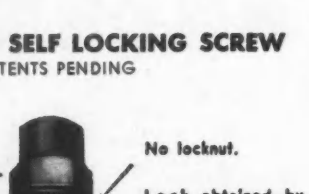
Johnson
"LOCK-TYTE" ADJUSTABLE
TAPPETS
WITH THE JOHNSON SELF-LOCKING SCREW

Designed and produced — for all types of internal combustion engines — by "Tappet Specialists," skilled engineers, and production craftsmen who have devoted years to the manufacture of the finest tappets made.

Johnson "Lock Tyte" Adjustable Tappets stay put and wear evenly — resulting in longer tappet life — greater valve protection — reduction of false motion — and less frequent engine overhauls.



THE JOHNSON SELF LOCKING SCREW
PATENTS PENDING


Finest steel, heat treated for maximum strength and hardness.
No locknut.
Lock obtained by live spring action of diaphragm.
Loads carried solidly on full length of firmly seated threads.
No leading edges to cut threads when screw is turned.

WRITE FOR FOLDER 46A

Johnson Products Inc.
TAPPETS ARE OUR BUSINESS
Muskegon, Michigan

PJ
.. for over 40 years
THE PIONEER
MANUFACTURER OF
AUTOMATIC CHUCKING EQUIPMENT
POTTER & JOHNSTON MACHINE CO.
PAWTUCKET, RHODE ISLAND

Be 100% With 10% Buy Bonds

stroke, required to do the job. Press size for drawing jobs is selected by giving the crankshaft diameter and tonnage away from bottom of stroke. Maximum press speed for the particular metal being drawn is also determined.

The Calculator measures 9½ in. by 9½ in. and is made of Vinylite plastic with a clear sheet of Vinylite over printed surfaces. The scales are laid out on paper-covered aluminum plates.

Convair Speeds Production of Aluminum Houses

Assembly-line methods may soon be applied to the production of aluminum houses in order to ease the present housing shortage in southern California. Harry Woodhead, president of Consolidated Vultee Aircraft Corp., said his company is already constructing a prototype of the aluminum house at the Vultee Field Division, Downey, Calif.

The two-bedroom house and lot are expected to sell for $7,000 to $8,000. When the program gets fully under way next spring, Convair expects to turn out between 80 and 100 houses a day.

New Ansul-Dugas Fire Extinguisher

Increased fire-stopping power is one of the advantages claimed for this new Ansul-Dugas dry chemical fire extinguisher announced recently by the Fire Extinguisher Division of Ansul Chemical Co., Marinette, Wis. Other features claimed are: simplified and faster operation, quicker and easier on-the-spot recharge, greater heat-shielding protection for the operator, expert extinguishing by inexperienced operators and greater capacity without increased weight.